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Cascade Mine
drainage

Final Report
Cascade Mine Drainage

DSL-AMRB 91-001
Near Towns of Centerville, Stockett and Belt
Cascade County, Montana

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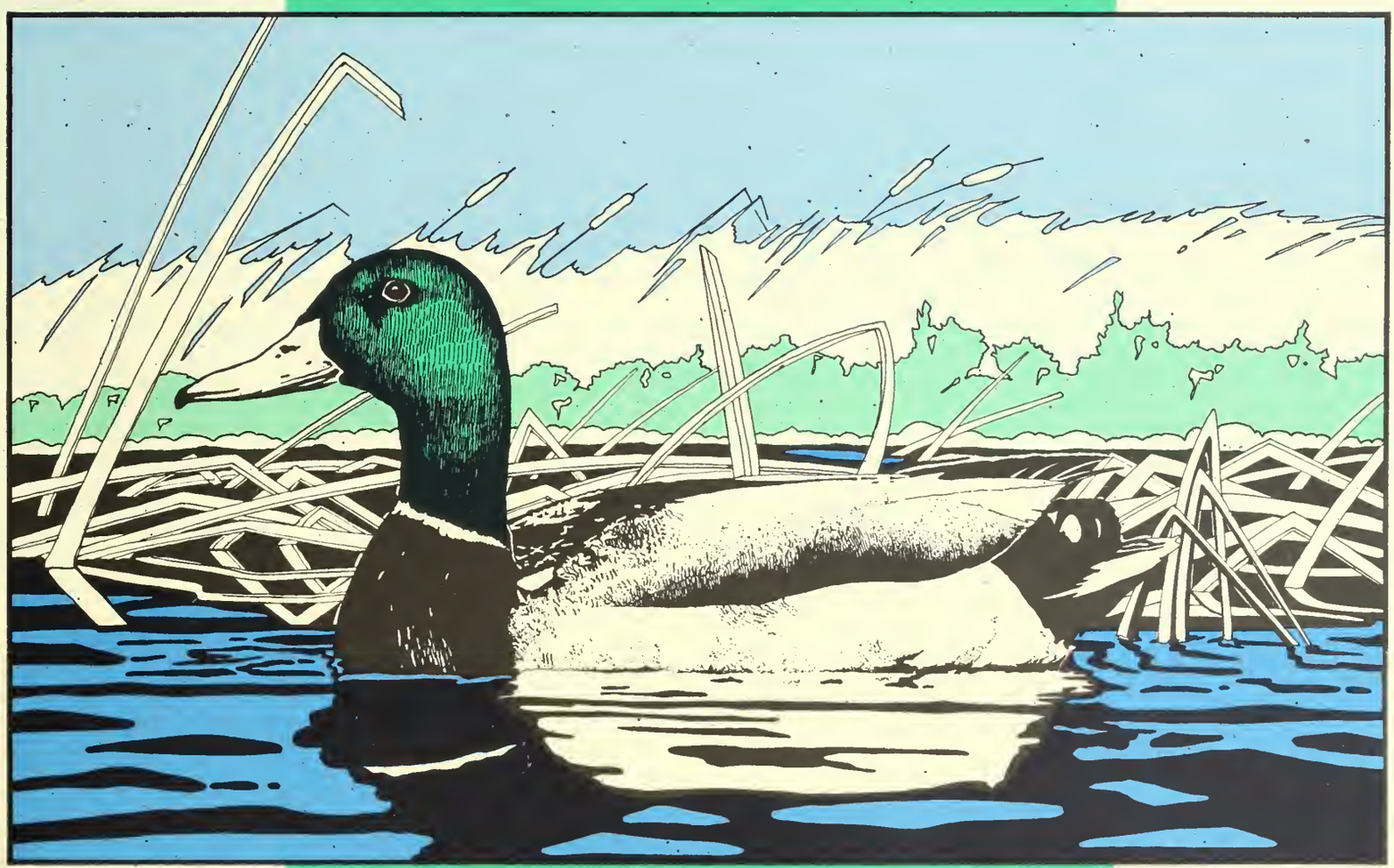

December, 1992
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FINAL REPORT

CASCADE MINE DRAINAGE

Department of State Lands
Abandoned Mine Reclamation Bureau
Project Number 91-001

Location

Centerville, Stockett & Belt, Montana
Sec. 18, 19 & 36, Township 19 North, Range 4 East and
Sec. 26, Township 19 North, Range 6 East
Southeast of Great Falls
In Cascade County, Montana

March 1993

Robert Peccia & Associates
Helena, MT

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1.0 INTRODUCTION

1.1 Project/Site Description

The Cascade Mine Drainage project involves two primary project sites on the outskirts of the towns of Centerville and Stockett, Montana. Two small sites which were added to the project through change order, are located on the outskirts of the town of Belt, Montana. The Centerville site is situated on a west facing slope of Sand Coulee Creek in the NE 1/4 of Sec. 19 and SE 1/4 of Sec. 18, Township 19 North, Range 4 East (Latitude 47°23′35″, Longitude 111°08′20″). The Stockett site is situated on the north end of a north/south trending ridge with east, north and west facing slopes and is near the confluence of Cottonwood Creek and an unnamed drainage. The legal description of the Stockett site is the SE 1/4 of Sec. 36, Township 19 North, Range 4 East (Latitude 47°21′20″, Longitude 111°09′40″). The Belt sites have a general legal description of the S 1/2 of Sec. 26, Township 19 North, Range 6 East (Latitude 47°22′37″, Longitude 110°55′45″), and are situated on northeast facing terraces of Belt Creek. In this report, the Centerville site is referred to as Centerville "C" and the Stockett site as Stockett SE. The Belt sites are referred to as the Belt Subsidence and the French Coulee Repair.

General geology of the area consists of a base of the Mississippian period Madison Group limestones. This is overlain by the Jurassic period Swift Formation, a sandstone ranging from 4 to 40 feet thick. The Morrison Formation (Jurassic) overlies the Swift and consists predominantly of mudstone and shale with interbedded lenses of limonitic sandstone. The top of the Morrison contains a 4 to 15 foot zone of black shale and bituminous coal overlying a transitional grey shale. This coal was the target of the mining activity in the area beginning in the 1880's. The Kootenai Formation (Lower Cretaceous) overlies the Morrison and is subdivided into five informal members. The basal member is a quartz arenite, coarse-grained sandstone, chert granule conglomerate that forms the roof of most coal mines in the area and also serves as an aquifer.

The topography of the project area is dominated by rolling hills of the nearby Little Belt Mountains which are cut by ephemeral creeks and coulees. The general area surrounding the agricultural towns of Centerville, Stockett and Belt have been impacted by the effects of past coal mining activity, most notably acid mine drainage. The surface water in the area is characterized by deep rust-colored creeks originating from mine adits and nearby seeps. The undisturbed vegetation is primarily good quality rangeland vegetation or small grain cropland. Dominant on the landscape are large areas where past reclamation activities have resulted in the establishment of vegetation in areas that formerly were devegetated hillsides devoted to coal waste dumps. Some reclaimed areas show signs of continued seepage of acid drainage from reclaimed adits. Both knapweed and leafy spurge have been introduced to the area and both occur on the project sites, and on other reclaimed lands in the area.

The area coal was mined for three primary uses; railroad operations, operating the smelter in Great Falls, and local home heating. All of the project sites except the Belt Subsidence were included in previous DSL-AMRB reclamation efforts.

1.2 Map Showing Mine Location

Maps showing the project vicinity are presented in Figures 1 and 2. Figure 3 shows the project location of the Centerville "C" and Stockett SE sites. Figure 4 shows the location of the Belt Subsidence and French Coulee sites. Record Drawings of the construction project are in Attachment G.

Figure 1
State Vicinity Map

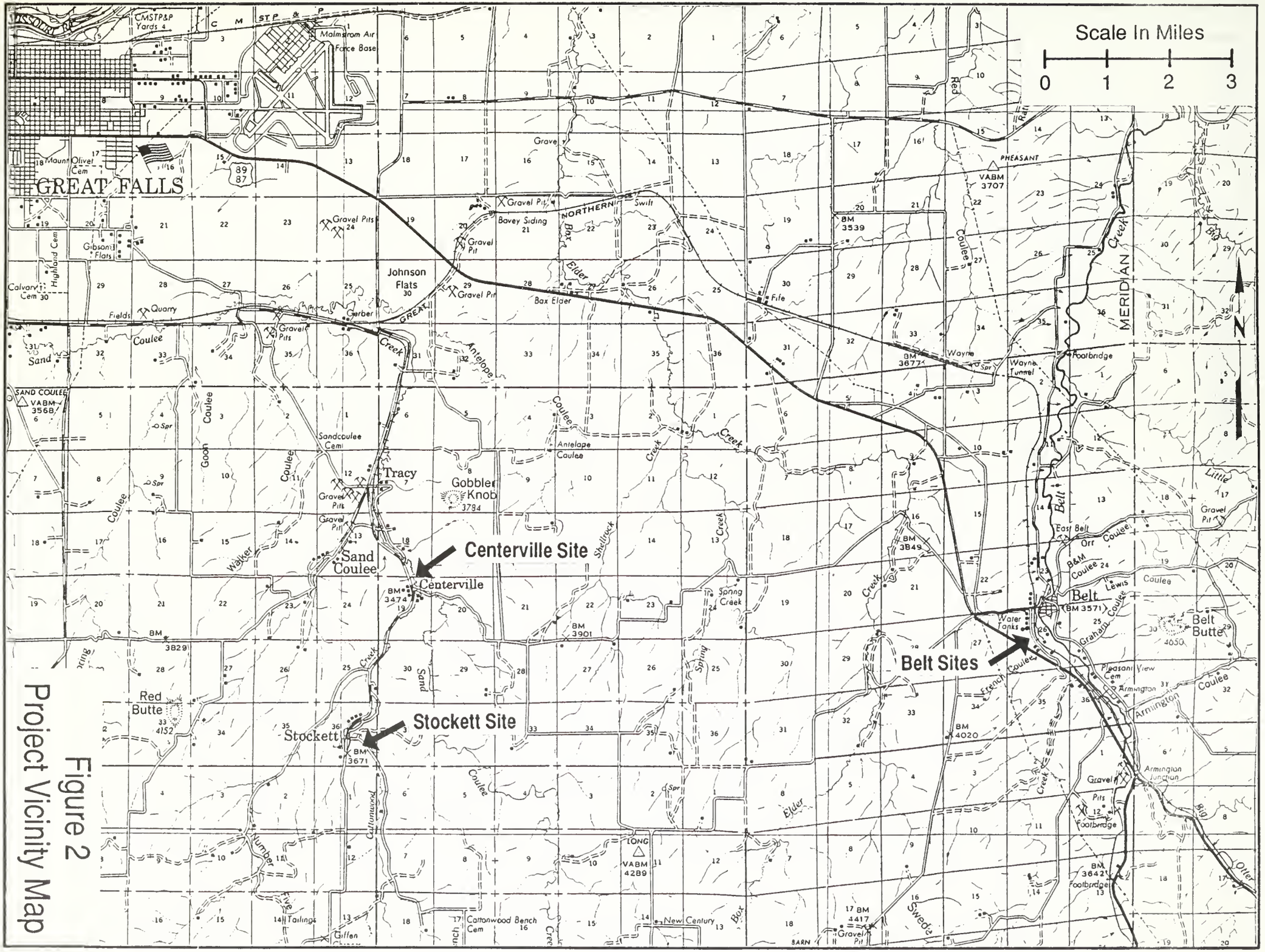
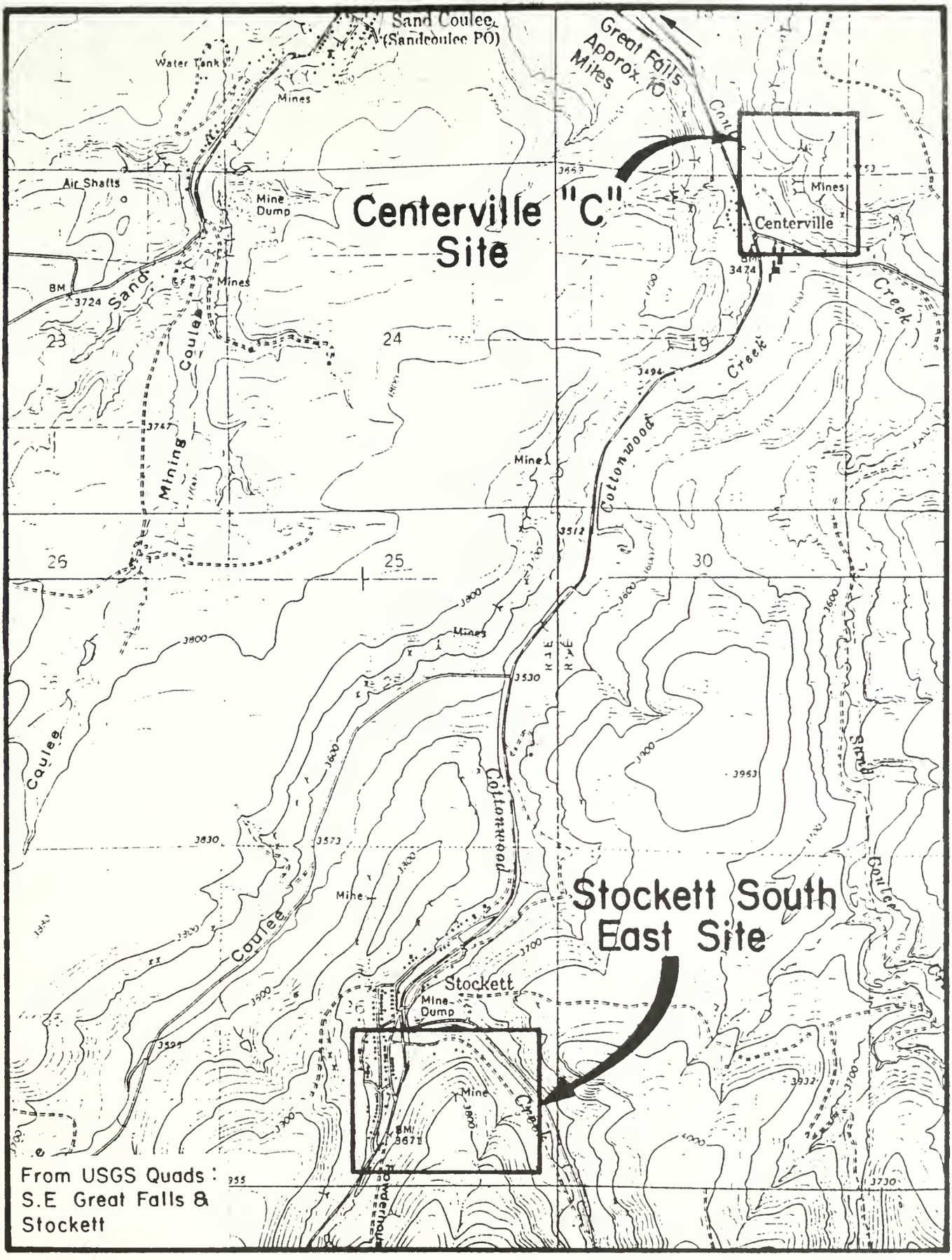


Figure 2
Project Vicinity Map



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Scale: 1:24,000

0 1/4 1/2 1 Mile

Figure 3
Project Location Map

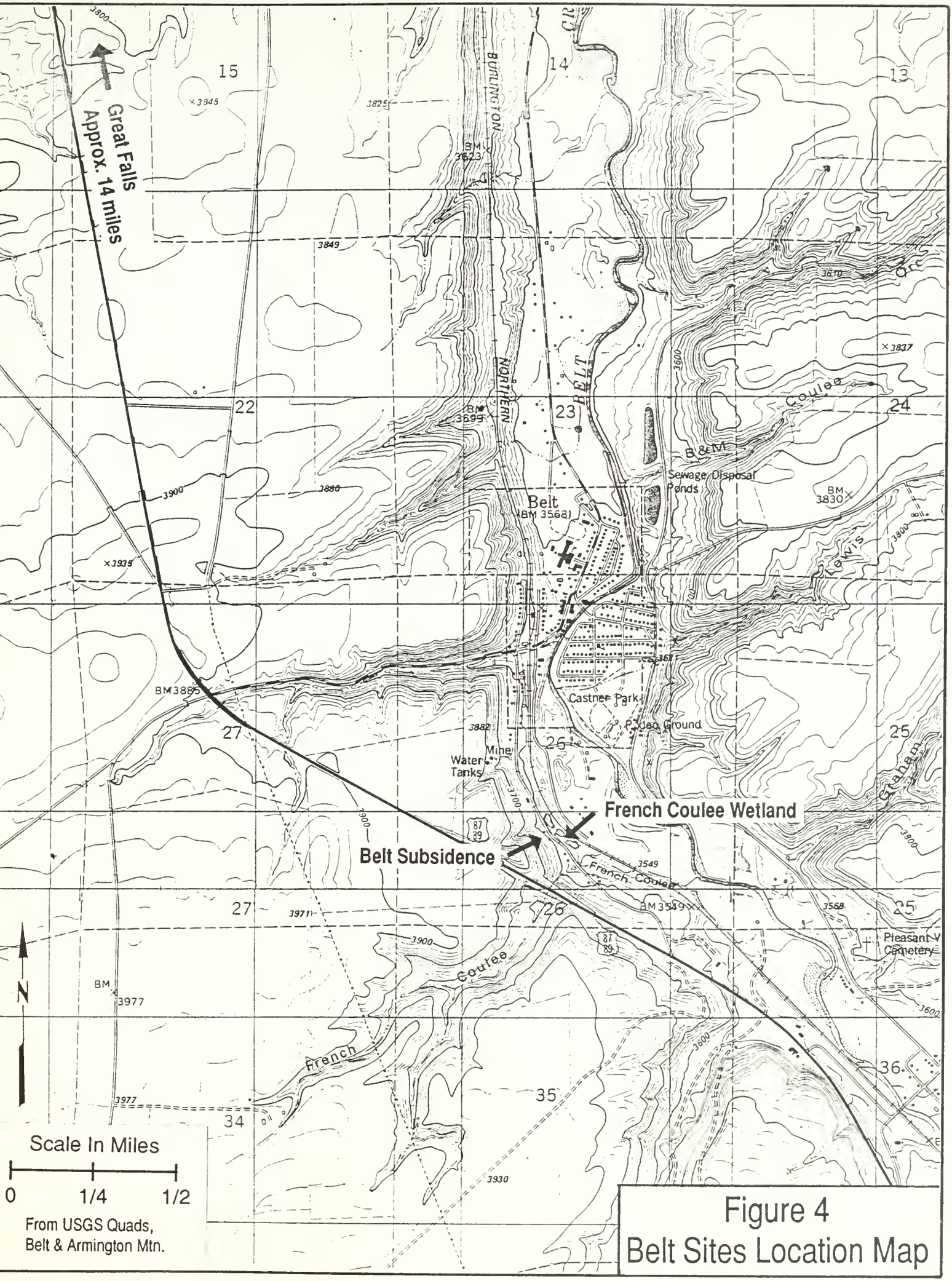


Figure 4
Belt Sites Location Map

1.3 Project Objectives

The primary objective of the project is to reclaim the disturbances at the Centerville "C" and Stockett S.E. sites resulting from past coal mining activities. Specifically addressed are Priorities 1, 2, and 3 of the Surface Mining Control and Reclamation Act, Title IV - Abandoned Mine Reclamation (Public Law 95-87). The priorities dictate the expenditure of moneys from the fund for the purposes of protecting public health, safety, general welfare and property from danger of adverse effects of mining practices and the restoration of land and water resources and the environment previously degraded by mining practices.

Environmental quality degradation from abandoned coal mine drainage waters is the predominant problem and focus of reclamation efforts in this project. The mine drainage waters are acidic and have high metal concentrations. These acid mine drainage (AMD) waters contaminate shallow ground water and surface water, eliminating aquatic life and vegetation. The acidic waters also represent a safety hazard to wildlife, livestock, and humans who drink the water. Hazardous mine openings also needed to be closed to restrict access.

A secondary problem is a shortage of usable water supplies and reduced grazing capacity from unvegetated areas, representing economic liabilities to landowners. Also, recreational opportunities are reduced due to lack of wildlife habitat and fish life, resulting in lower economic value to the community. Unvegetated and metals stained drainages are unsightly and detract from the aesthetics of the area.

Most of the mine-related problems in the project area have been addressed in past reclamation projects, but many of the acid mine drainages still exist. Although experimental in nature, wetlands have been found to be successful in ameliorating AMD problems and have been constructed as a primary long-term, low-maintenance solution. A long term objective of the project is to determine the effectiveness and longevity of design concepts for possible incorporation into other AMR projects.

The following are the construction objectives of this project for each site:

A. Centerville "C"

- Prepare & Reclaim Access
- Grade Wetland Basin - 1.5 ac
- Grade High-Flow Bypass Channel
- Install Passive Anoxic Limestone Drain
- Install Wetland Inlet & Outlet Structures & Bypass Channel Outlet
- Install Wetland Liner System, Underflow Gravel Layer & Organic Growth Substrate
- Transplant Wetland Vegetation
- Lime Acidified Soils - 1.6 ac
- Install Seep Interceptor System
- Install Mine Drainage Control System
- Close 2 Mine Openings
- Fertilize, Seed, Mulch & Fence Disturbed Areas - 3.8 ac

B. Stockett SE

- Prepare & Reclaim Access
- Grade Wetland Channel Basins - 0.4 ac
- Install 2 Passive Anoxic Limestone Drains
- Install Mine Seep Interceptor System
- Install Mine Drainage Control System
- Install Wetland Liner System, Wetland Channel Dike System & Organic Growth Substrate

- Transplant Wetland Vegetation
- Close 2 Mine Openings
- Lime Acidified Soils - 11 ac
- Fertilize, Seed, Mulch & Fence Disturbed Areas - 11.7 ac

C. Belt Subsidence

- Prepare & Reclaim Access
- Explore and Backfill Recently Identified Mine Subsidence
- Fertilize, Seed & Mulch Disturbed Area - 0.5 ac

C. French Coulee Wetland Repair

- Replace Broken Pipe Cleanout Access
- Install AMD Flow Shutoff Valve and Flow Bypass Capability

2.0 RESPONSIBLE PARTIES

2.1 Contractor

The project consisted of two separate construction schedules. The general contractor for Schedule 1 of the project was Sharbono Construction, Inc., 1826 North Main, Helena, MT 59601. The general contractor for Schedule 2 was Ed Bolland Construction, Inc., 2608 9th Avenue North, Great Falls, MT 59401. The project supervisor for Sharbono was Loren Sharbono and the project supervisor for Bolland was Barry Bolland.

2.2 Engineering

The engineer for the project was Robert Peccia & Associates (RPA), 825 Custer Avenue, Helena, MT 59601. The engineering services provided by RPA included preliminary and design engineering and construction management. The project manager for RPA was Robert Morton who also served as substitute observer. The primary construction observers for RPA were David Zimmer and Nancy Granger.

2.3 AMRB Coordination

The Abandoned Mine Reclamation Bureau (AMRB) manager for project design was Stu Levit and the AMRB manager for project construction was John Koerth.

3.0 DESCRIPTION OF RECLAMATION CONTRACT

3.1 Bidding and Pre-Construction Administration

The project proposal was arranged with Schedule 1 for the reclamation earthwork and Schedule 2 for the transplanting of wetland vegetation and trees. Both schedules had additive alternates for the inclusion of an additional wetland to treat AMD water at the Stockett SE site. The alternates were not awarded.

The project was advertised in three newspapers by the AMRB prior to the bid opening on June 13, 1991. A pre-bid conference was held on June 3, 1991 at the Centerville "C" site. The following individuals were in attendance:

Stu Levit, AMRB
Robert Morton, RPA
Mike Ogden, RPA

Lonnie Anderson, United Materials
Joe Aline, Shumaker
Russ Martin, Martin Peat
John Leinan, EKO Compost
Jack Sturgis, Heritage Supply
Jim Higgins, Envirocon
Mel Armold, Hobson
Kirby Kenney, Kenney's Inc.
Frank Donnes, Donnes Construction
Barry Bolland, Bolland Construction
John Lawson, Blattner
John Montgomery, Montgomery Construction
Bill Sudan, Sudan, Inc.
Dan Warwick, Sharbono Construction
George Brocklehurst, Hallett Reclamation Company
Irving Sewell, Hallett Reclamation Company
Randy Nesmith, Hallett Reclamation Company

Subsequent to the Pre-Bid meeting, an addenda was issued to the planholders. A copy of the addenda is included in Attachment A. The bid opening was conducted by AMRB on June 13, 1991. Bids were received from the following contractors.

Sharbono Construction
1826 North Main
Helena MT 59601
Schedule 1 Base Bid $483,458.00
Schedule 2 Base Bid $0.00

Shumaker Trucking and Excavation Contractors, Inc
P.O. Box 1442
Great Falls, MT 59406
Schedule 1 Base Bid $515,873.00
Schedule 2 Base Bid $70,620.00

Hallett Reclamation Company
P.O. Box 169
Livingston, MT
Schedule 1 Base Bid $543,819.13
Schedule 2 Base Bid $0.00

D.H. Blatner & Sons, Inc.
Box 2007
Missoula, MT 59806 and
Avon, MN 56310
Schedule 1 Base Bid $605,267.80
Schedule 2 Base Bid $0.00

Ed Bolland Construction, Inc.
2608 9th Avenue North
Great Falls, MT 59401
Schedule 1 Base Bid $681,913.25
Schedule 2 Base Bid $61,625.00

The Engineers estimate was $457,186.25 for Schedule 1 Base Bid and $24,250.00 for Schedule 2 Base Bid. The average of the five Schedule 1 Base Bids is $566,066.23 and the average of the two Schedule 2 Base Bids is $66,122.50. A copy of the bid tabulations is included in Attachment A of this report. The bids were checked for correctness and tabulated by AMRB. Bids were then forwarded to Robert Peccia & Associates for review and recommendation.

Sharbono Construction was selected as the lowest responsive bidder for Schedule 1 of the project and a Notice of Award was issued effective June 26, 1991. A preliminary Pre-Construction meeting was held on July 11, 1991 which discussed paperwork requirements for the project. The Agreement between Sharbono and DSL was executed on July 29, 1991. Copies of the Notice of Award and the Agreement are included in Attachment A of this report. The Notice to Proceed was issued to Sharbono on August 1, 1991. Work was scheduled to begin no later than August 1, 1991 and be completed within 90 calendar days for a completion date of October 29, 1991. A copy of the Notice to Proceed is included in Attachment A of this report.

Bolland Construction was selected as the lowest responsive bidder for Schedule 2 of the project and a Notice of Award was issued effective July 12, 1991. A pre-construction Change Order No.1 was issued to Bolland on July 16, 1991 to adjust the wetland planting density. A copy of this change order is included in Attachment B. The Agreement between Bolland and DSL was executed on August 26, 1991. The Notice to Proceed to Bolland was issued on April 20, 1992. The delay between the Agreement and Notice to Proceed was requested by Bolland as they preferred a spring planting season and the delay was required because of a lag in completion of Schedule 1 work. Schedule 2 work was scheduled to begin no later than April 27, 1992 and be completed within 90 calendar days for a completion date of July 25, 1992. Copies of the Notice of Award, the Agreement, and the Notice to Proceed are included in Attachment A to this report.

3.2 Construction Administration

A Pre-Construction conference related to Schedule 1 was held on July 19, 1991 and the meeting summary is included in Attachment A. Schedule 1 construction commenced on Thursday August 1, 1991 with 5 personnel including one supervisor, two equipment operators, and two laborers. An informal Pre-Construction meeting related to Schedule 2 was held with Bolland on April 30, 1992. Schedule 2 work commenced on April 30, 1992 with six personnel including one supervisor, one equipment operator and four laborers. A Robert Peccia & Associates employee was present virtually full time as a construction observer.

A. Change Orders and Work Directives - Schedule 1

Schedule 1, Change Order No. 1 was executed on October 4, 1991. Change Order No. 1 consisted of three primary items and increased contract time by 30 days, for an effective completion date of November 28, 1991. The three primary items of Change Order No. 1 are summarized below.

Change Order No. 1, Item 1 increased wetland size at the Centerville "C" site based on newly available sizing recommendations. These recommendations use acidity loading in lieu of iron loading to the wetland and result in larger wetland sizes for highly acidic mine drainage treatment. The wetland size at the Centerville site was maximized for the area available, and resulted in a change from 0.9 planned acres to 1.6 actual acres of total wetland area. Iron loading size recommendation was 0.7 acres while the acidity loading size recommendation was between 2.6 and 5.2 acres. Peat substrate thickness changed from 1.5 to 2.0 feet in the original bid to 2.0 to 2.5 feet after the change order. Filter gravel substrate thickness changed from 1.0 to 1.5 feet in the original bid to 1.5 feet after the change order. The increased size resulted in quantity increases for the following bid item numbers: 4, 5, 6, 7, 9, 12, 15, 17, 18, 22, 23, and 27. A new item, Peat-OM provided a less expensive wetland organic substrate.

Change Order No. 1, Item 2 added limestone aggregate as a new construction item. Recent research recommendations are to include 20%-25% (dry wt.) limestone aggregate into wetland organic substrate to optimize acid drainage treatment. The limestone is mixed into all peat in the wetlands.

Change Order No. 1, Item 3 involved installation of additional interceptor drains and adding tiers of geocomposite in the interceptor drains. During construction, excavation and installation of project interceptor drains revealed that AMD was moving through the soil profile at several elevations. Installing more than one tier of geocomposite in certain locations more effectively captured acid seepage. Also, additional interceptor drains were deemed necessary to improve coverage of the impacted slope. The result was increased quantities of bid items 16, 17, and 18.

Three Work Directive Changes were issued for Schedule 1 work. Work Directive Change (WDC) No. 1 added 3 days of contract time; involved cleanout of existing 4" PVC pipe at the Centerville "C" site; provided for additional piping and appurtenances; and involved closure of an additional mine opening found at the Stockett SE site. Work Directive Change No. 2 added 10 days to the contract time (including compensation for 4 weather days since winter shutdown); involved hand closure of an additional mine opening found at the Centerville "C" site; and involved placement of limestone veneer on small AMD seeps at both the Centerville "C" and Stockett SE sites. Work Directive Change No. 3 added 3 days to the contract time and involved closure of a mine subsidence at Belt, Montana (Belt Subsidence site). Copies of each Work Directive are in Attachment B. The net effect on contract time resulting from the three WDC's is an additional 16 days, making the effective contract completion date December 14, 1991.

Change Order No. 1 resulted in a net overall increase of $139,151.90 for a total contract price of $622,609.90. This equates to a 28.8% increase in project cost over that originally bid for Schedule 1. No Final Change Order was issued for this project, but the change in contract amount reflected in the January 25, 1993 Final Pay Request resulted in a net overall increase of $74,998.26 for a total contract price of $697,608.16. This equates to a 10.8% increase in project cost over the contract amount adjusted by Schedule 1, Change Order No. 1.

B. Change Orders and Work Directives - Schedule 2

Two change orders were included in the Schedule 2 work. As described above, the pre-construction Change Order No. 1 was issued to Bolland on July 16, 1991 to decrease the wetland planting density from two (2) plants per square foot to one (1) plant per every two (2) square feet. Change Order No. 2 - Final, was issued to reconcile bid quantities to reflect actual quantities installed as well as to include Work Directive Change No.1 lump sum work. Work directive Change No. 1 of Schedule 2 involved the inclusion of modifications and repairs of the French Coulee wetland piping at Belt, Montana (French Coulee Repair site). Copies of the Change Orders and Work Directive are included in Attachment B of this report.

Combined, the two change orders resulted in a net decrease in Schedule 2 of $31,970.00 for a final contract price of $29,655.00. This equates to a 51.9% decrease in contract price under that originally bid for Schedule 2.

C. Work Stoppages

A number of work stoppages and time increases occurred on this project. A breakdown of the changes in contract time for Schedule 1 of the project follows in Table 1.

TABLE 1. Contract Time - Schedule 1

DESCRIPTION	DATES	NUMBER OF DAYS	RUNNING TOTAL CONTRACT DAYS
Original Contract	8/1/91 - 10/29/91	90	90
WDC No.1	Issued 8/7/91	3	93
Change Order No.1	Issued 10/4/91	30	123
Weather Days	8/1/91 to 11/28/91, see file letters 11/8/91 & 12/5/91	15	138
Recommended Extension	12/5/91 file letter	21	159
Winter Shutdown	11/28/91 to 3/16/92	108	267
WDC No.2	Issued 4/24/92	6	273
Weather Days	3/16/92 to 7/13/92	8	281
Requested Extension To 6/30/92	Response in 7/15/92 file letter	52	333
WDC No.3	Issued 7/27/92	3	336
Non Requested Time to Substantial Completion	7/1/92 to 7/23/92	23	359
Total Time		359.00	

Work stoppages for Schedule 2 construction were tied to Schedule 1 time frames. This was due to the fact that Schedule 2 work, planting wetland vegetation, was dependant on Schedule 1 earthwork being complete. There were two periods of Schedule 2 work. The first period began on April 30, 1992 and ended on May 5, 1992. This work included planting cattails in the Centerville wetland cells one and two as well as planting trees in Centerville Centennial Park. The second period began June 30, 1992 and ended on August 12, 1992. This work included completion of wetland planting and repairs and maintenance to the French Coulee treatment system.

D. Requests for Payment - Schedule 1

Payment was made on seven payment requests for Schedule 1 of the project. Table 2 summarizes these requests.

TABLE 2. Schedule 1 Payment Requests

PAY REQUEST NUMBER	DATE	AMOUNT OF REQUEST
1	08/20/91 TO 09/27/91	$62,065.71
2	08/28/91 TO 09/27/91	$68,127.75
3	09/28/91 TO 10/31/91	$41,275.82
4	11/01/91 TO 11/30/91	$91,780.94
5	11/30/91 TO 04/30/92	$132,364.87
6	05/01/92 TO 08/31/92	$200,097.92
7 - Final	09/01/92 TO 01/25/93	$101,895.15
TOTAL CONTRACT AMOUNT		**$697,608.16**

Copies of each Pay Request are included in Attachment C to this report.

E. Requests for Payment - Schedule 2

Schedule 2 Payment Request No.1, totaled $12,991.50 for work completed between April 27, 1992 and June 23, 1992. Schedule 2 Payment Request No.2 - Final, totaled $16,663.50 for work completed between June 24, 1992 and August 12, 1992. Copies of both Payment Requests are included in Attachment C to this report.

F. Substantial Completion

Final inspection of this project involved five field trips with AMRB staff. John Koerth, AMRB, visited the sites on July 22, 1992. John Koerth and Robert Morton, RPA, inspected the sites on July 7, 1992. John Koerth, Joel Chavez, AMRB, Earl McCurley, AMRB, and Robert Morton visited the Belt site on July 29, 1992. John Koerth and Earl McCurley visited the sites on August 31, 1992. On September 28, 1992 John Koerth, Earl McCurley and Robert Morton again visited all the sites. During these visits, construction progress, punch-list items and warranty items were reviewed.

Substantial completion of Schedule 1 was granted effective July 23, 1992. Substantial completion of Schedule 2 was granted effective August 12, 1992. Copies of both schedules Certificate of Substantial Completion as well as other required construction closeout forms are included in Attachment D.

G. Final Completion and Approval

The Schedule 2 Final Pay Request, Schedule 1 Payment Request No.6, Affidavit on Behalf of Contractor, Contractor's Certificate of Completion, Certificate of Substantial Completion, Consent to Surety Company to Final Payment, and Certificate of Acceptance were prepared, executed and forwarded to AMRB throughout August and September of 1992. Copies of these required construction closeout forms are included in Attachment D.

The contractor disputed the final payment quantities for Schedule 1 work. This resulted in a delayed submittal of the final Pay Request. Primary dispute items involve the three types of peat, lime application, hypalon liner, and filter gravel payment items. The dispute was resolved amiably, and final payment made on January 25, 1993.

4.0 CONSTRUCTION

4.1 Description of Project Plan

The project was divided into two main sites; Centerville "C" and Stockett SE. Two additional sites were added through work directives; Belt Subsidence and French Coulee Repair. The project was also divided into two Schedules, Schedule 1 construction earthwork and Schedule 2 vegetation transplanting. In the original bid package an Additive Alternate was included to add a wetland cell at the Stockett site. This Alternate was not awarded. A listing of the project work task descriptions for the Centerville, Stockett, Belt and French Coulee sites follows. Please refer to the Record Drawings in Attachment G for additional information.

CENTERVILLE "C" SITE

- Removed and relocated existing 42" CMP to new site access location.
- Removed and salvaged existing fences.
- Constructed access roads.
- Installed 20′ of 18" PE culvert under new access road across north drainage.
- Closed Adit #2 & #1.
- Constructed interceptor drains, locations shown on the Record Drawings.
- Cleaned out existing 4" PVC line.
- Provided trench dewatering. Discharged into bypass systems, not into wetland cells or limestone trenches.
- Installed PVC drain pipes connecting the interceptor trenches to the drain lines leading to the discharge areas. The Contractor made all necessary connections and provided concrete anchors (thrust blocks).
- Provided pipe cleanouts every 100′ on all new pipe runs including those in the interceptor drains.
- All piping buried a minimum depth of 4′. Additional cover material placed over any sections of pipe not be buried 4′ deep due to bedrock or other factors.
- Constructed surface collection basin with weir outlet structure.
- Constructed limestone trench.
- Installed limestone veneer at small seep locations.
- Installed 2 service holes and provided PVC fittings.
- Excavated and stockpiled all topsoil and subsoil from the areas where the wetland cells were constructed.
- Constructed 3 wetland cells.
- Graded slope upgrade of the cells to provide a route around the cells for surface runoff.
- Installed outflow ditches from the wetland cells to the adjacent cell or drainage channel.
- Provided 1000 gallon fiberglass stock tank with valve and piping.
- Removed and salvaged existing 12" PVC pipe near stream channel to on-site location and to landowner.
- Regraded north drainage channel.
- Installed weir structures and wetland piping.
- Installed bentonite seal, liner, gravel, and peat in wetland cells. Installed hay bale dikes in the wetland cells.
- Transplanted wetland vegetation in wetland cells.
- Flooded wetland cells with clean water (source from nearby Centennial Park well). This was done a minimum of one week before turning on mine drainage.

- Reclaimed all areas within the project site that did not support a healthy stand of vegetation. All areas disturbed during construction also were reclaimed.
- Reclamation consisted of an initial grading to remove erosion rills. Application and incorporation of lime to existing devegetated areas. Placement of 4" cover soil on limed areas. Soil generated by on site and imported. Fertilized, seeded and mulched all devegetated areas as well as construction disturbed areas including temporary haul/access roads. Construction disturbed area seedbed preparation included regrading and ripping.
- Grading of devegetated area #1 also included grading slumped soil to create a uniform slope while constructing a 5′ wide slope terrace. The terrace is sloped approximately 1% into the hill and has about a 1% grade toward the existing drainage.
- Constructed a permanent 5-strand barbed-wire farm fence (Type F-5M) around the wetland cells and the surface collection basin.
- Installed sections of 4-strand farm fence type (F-4M) as shown on the Record Drawings.
- Installed Erosion control mat on devegetated area #1 and north drainage channel.
- Transplanted trees to Centerville Park.

STOCKETT SE SITE

- Protected from cattle entering work area.
- Constructed access roads.
- Installed interceptor drains, locations shown on the Record Drawings.
- Installed 4" PVC drain pipes and bypass lines that lead from the interceptor drains to the limestone trenches and the discharge areas. The Contractor made all necessary connections and provided concrete anchors (thrust blocks).
- Installed 2 pre-cast concrete service holes and provided PVC fittings as required.
- Constructed 2 limestone trenches.
- Installed limestone veneer at small seep locations.
- Provided trench dewatering. Temporary piping was left in place at the North Wetland Channel.
- Installed pipe cleanouts every 100′ on all pipe runs including those in the interceptor drains.
- All piping was buried at a minimum depth of 4′. Additional cover material was placed over sections of pipe that were buried 4′ deep due to bed rock or other factors.
- Excavated and stockpiled all topsoil and subsoil from the areas where the wetland channels, trench drains, and limestone trenches were constructed.
- Constructed the wetland channels, including bentonite seal, liner system, gravel and peat.
- Transplanted wetland vegetation in the wetland channel.
- Reclaimed all areas within the project site that did not support a healthy stand of vegetation. All areas disturbed during construction were also reclaimed.
- Reclamation consisted of an initial grading to remove existing erosion rills. Application and incorporation of lime to devegetated areas. Placement of 4" of cover soil on limed areas. Soil generated on site and imported. Fertilized, seeded and mulched all disturbed areas including temporary haul/access roads. Road seedbed preparation included ripping.
- Constructed a permanent 5-strand barbed wire fence (Type F-5M) around the wetland channel.
- Farm fence disturbed during construction was repaired to standards specified in the Standard Specifications.
- Hand Close Adit #1 and Adit #2.

BELT SUBSIDENCE SITE

- Mobilized and provided access to site.
- Conducted exploratory excavation of subsidence hole.
- Compacted on-site and imported fill in subsidence.
- Graded disturbed area surface.
- Fertilized, seeded, and mulched disturbed area, including disturbed access.

FRENCH COULEE WETLAND SITE REPAIR/MAINTENANCE

- Mobilized and provided access to site.
- Located and excavated buried manhole and main inlet line to wetland.
- Removed temporary grout blockage from manhole.
- Installed head control piping in manhole and new gate valve with riser on main wetland inlet line.
- Excavated and replaced broken cleanout riser.
- Graded disturbed areas.

4.2 Planning and Design

The Cascade Mine Drainage project was first conceived in 1989 when preliminary investigation of existing AMRB data and inventories were reviewed for acid mine drainage sites. Consequently, six sites in Cascade County were chosen for incorporation into an OSM program grant narrative. All of the chosen sites had been included in previous AMRB reclamation efforts, but treatment of mine drainage had not been specifically addressed. In the fall of 1990, landowners were contacted for consent for entry and preliminary design efforts began on two sites, Centerville "C" and Stockett SE. In the spring of 1991, RPA was assigned the project design with the intent that the project be bid in late spring. Plans and specification were prepared, permits applied for, and consent reverified. Much of the permitting and all of the Environmental Assessment and community relations requirements were conducted by the AMRB staff.

Several "state of the art" experimental options for mine drainage control and treatment were reviewed for incorporation into the project. These included alkaline recharge trenches, anoxic limestone drains (ALD), wetlands (anaerobic, aerobic, and combined), groundwater artificial recharge, mine sealing, alternative cropping to reduce groundwater recharge, active chemical treatment, bactericide injection, surface liming, and revegetation. The experimental design chosen parallels most recent and most successful treatment research findings, and primarily involves wetlands and ALD's.

Soil and water sampling and analysis was conducted and drill holes were installed with PVC casing. The resulting information was incorporated into design amendment rates, treatment methods and plan detail drawings. The 100-year flood maps were consulted and all work except the stock tank, its associated valve, the reinstalled access culvert, and some fencing are out of this flood level. Existing plan sheets from previous AMR projects, which were generated from air photogrammetry, were used as the project base maps.

Consent to construct the work at the Centerville "C" site was obtained from Otto "Gene" Johnson, Leo Marko, and the Centerville School Board (Miners Centennial Park). Additional consent was obtained from Mr. Johnson when wetland size was expanded at the Centerville "C" site through Change Order No.1. Consent to construct the work at the Stockett SE site was obtained from Dave Marko and the Cascade County Highway Department. Bob Klasner an adjacent landowner gave verbal approval, but withheld written consent to install the Additive Alternate on the project contingent upon DSL monetary assistance with proposed sewer work in Stockett. Even though DSL elected not to pursue the sewer work, after Change Order No.1 was executed, Mr. Klasner volunteered his property for the Additive Alternate work. It was explained to him that the monies had been allocated to other portions of the project included in Change Order No.1. Landowners George Darga, George Bestwina and Dick Ballatore consented to work on the Belt Subsidence site. Consent to conduct work on the French Coulee site had been previously obtained and the work was considered maintenance of the original French Coulee Project requiring no additional consent.

Numerous research authors and their publications were referred to for the design. The primary research groups included the U.S Bureau of Mines in Pittsburgh, Pennsylvania, the Tennessee Valley Authority in Chattanooga, Tennessee, the Colorado School of Mines in Golden, Colorado, and West Virginia University in Morgantown, West Virginia. Also, much of the design work for this project was selected and modified from previous and concurrent AMR designs including Johnson Wetland, Upper Blackfoot and French Coulee.

In the spring of 1991, the design concept of the wetland at Centerville was to size the wetland system to accommodate the largest available area at the site. Before bidding, AMRB requested that the cost be reduced. The wetland size was reduced to correspond to the minimum area necessary for treatment, based on the available baseline data and current published sizing recommendations. In the interim, new research findings recommended using acidity loading rates instead of iron loading rates to size wetlands. It was determined that the bid size of the wetland would yield inadequate treatment. After consultation with AMRB, additional design work was conducted during construction to maximize wetland size. The added work was included in Change Order No.1. Wetland size prior to bid was based on iron loading rates while the new recommendations based sizing on acidity loading rates limited by available area.

Wetland substrate design included a filter gravel underlayer with a compost growth medium (designated as peat in the construction contract) above the gravel. The substrate design is based on current research findings and on an AMRB funded study of peat/gravel permeability testing and growth medium comparisons. Two types of EKO Compost peat were included in the project design at the time of the bid: standard Peat and Peat-DCW, a mixture of peat and dried poultry waste to facilitate growth of sulfate reducing bacteria in the last or polishing wetland cell. Due to the increase in wetland size, a third type of growth material (Peat-OM) was specified to keep costs low. Peat-OM is a mixture of cattle manure and straw. An option that was considered was the use of municipal waste from Great Falls instead of cattle manure. This option was not chosen largely because of supplier liability concerns. An addition to the design was mixing about 25% by weight limestone aggregate with the peat. Both the additional limestone aggregate and the additional peat type (Peat-OM) were included in Change Order No.1.

Filter gravel was specified to have a calcium carbonate content of less than 3%. Due to a substantially higher cost of providing the specified gravel material, the Contractor submitted a substitution request for filter gravel to allow a calcium carbonate content of about 9%. This request was granted based on testing conducted during construction of the French Coulee Wetland which showed no significant armoring of the gravel material taken from the same suppliers pit location.

The wetland channel design constructed at Stockett was developed to transport the intercepted acidic water as well as provide treatment while minimizing area used. A primary desire was to test the concept of a long, lineal wetland for possible incorporation into future AMRB mine drainage treatment projects. Conceptually, the design provides for a continuing series of oxidizing and reducing conditions to treat the acidic water. This was accomplished by installing baffled check dams along the channel grade at 50 foot increments. A challenging aspect of the design was to maximize effective treatment area given the severely limiting topography. This was accomplished by utilizing existing topographic features and installing a surface exposed liner, warranted for 20 years, rather than use up treatment area with backfill material to cover a non-exposable liner.

The liner systems designed for this project consisted of a bentonite amended soil (bentonite seal) overlain by a membrane liner of either 30 mil PVC or 45 mil hypalon. The PVC system required a soil cover because of its lack of ultraviolet resistance. The hypalon system was used where the available area constraints were restrictive. The hypalon system is very durable, is UV resistant and does not require a soil cover; however, it is more expensive.

Like the wetland design, the ALD designs were also based on the available baseline data and current published sizing recommendations. This design information indicated ALDs would be an effective treatment method. After construction began, chemistry of newly intercepted seep water showed significantly higher levels of dissolved oxygen than previously measured. These data coupled with new ALD design recommendations indicated that the ALDs could incur a reduction in longevity due to metals precipitation. Consultation with AMRB resulted in the decision to continue with the design as bid because of the potential that newly intercepted acidic waters would equilibrate to less oxidized conditions.

Lime rates based on design phase soil sampling were backed up by field soil analysis during construction. The liming rates were based on pH, active acidity and sulfur forms. Results of sampling performed during

construction identified a wide range of soil acidities. This variability can be accounted for by both the inherent pre-construction conditions and construction methods. The suspect construction methods included excavation and surface exposure of soils at depths not sampled during design, as well as mixing of acidified subsoils with coversoil during salvage. The variation in potential soil acidity resulted in a revision of lime amendment rates based on soil analyses performed during construction. Because liming rates were no longer uniform over each site, a field change was made in the lime measurement method to be based on the quantity of lime applied rather than by the area of lime applied. The lime quantity measurement was then converted back to area measurement as a basis for payment.

A unique aspect of the design involved the seep interceptor drains. French drains are more typically constructed to collect seepage. A french drain involves trench excavation, lining of the trench with drainage fabric, installation of perforated pipe, gravel backfilling of the trench, and enveloping the gravel with the drainage fabric. This method requires considerable work effort in the trench, large quantities of gravel and a need to dispose of excavated soil replaced by the gravel. Given the large amount of interceptors needed, this method would have increased the cost of the project considerably. The design utilized on this project eliminated the need for gravel and disposal of excavated soil by using manufactured geocomposite material and perforated pipe. The base of the geocomposite was wrapped around flexible perforated pipe in 50 foot long sections. The system allowed the majority of interceptor drain construction to be conducted above ground and not in the trench. This design reduced time and materials and improved safety conditions when compared to the standard french drain design. During construction trenching, additional seep locations were identified. This required additional widths of geocomposite and additional lengths of interceptor drain in some locations. The added costs were estimated and included in Change Order No.1.

Additional discussion on the project design and the flow control workings is included in the Operations and Maintenance Plan portion of this report (Attachment F).

4.3 Construction Activities

Sharbono Construction began Schedule 1 work on August 1, 1991. They had from 4 to 16 workers on-site with an average of about 9 workers employed on the project. Subcontractors for Sharbono included a local sewer servicing company from Great Falls (2 employees); a local rancher for some of the fencing work (up to 3 employees); another local resident to haul a portion of the imported coversoil (1 employee); McDaniel & Sons of Neihart subcontracted the portion of the seeding work that required hydroseeding (3 employees); and Environmental Liners of Cortez Colorado subcontracted the installation of the membrane liners. Numerous suppliers were involved in the project with the primary suppliers being Elk River of Helena for service holes and weir boxes; Northwest Pipe of Billings for piping, valves, appurtenances and geocomposite; EKO Compost of Missoula for peat and peat-DCW; Montana Limestone of Billings and NCP of Whitehall for lime products; Agri Feeds of Helena for fertilizer; Treasure State Seeds of Fairfield for seed and; Dikman Excavating of Great Falls for filter gravel.

Bolland Construction began Schedule 2 work on April 30, 1992. They had from 2 to 11 workers on-site, with an average of about 6 workers employed on the project. Bolland did not use any subcontractors. Schedule 2 primary suppliers were for the cattails and the trees.

To facilitate a description of work methods, following is a breakdown of work activities on a monthly basis. Please refer to the inspector's diaries in the project file and the project photographs in Attachment H for more detail.

AUGUST 1991 Sharbono Construction started work on August 1, 1991, with 5 Sharbono employees. During this period 4 to 6 employees were on the job, with an average of 5 men. Primary work activities took place at the Centerville site. Site access was accomplished by removing and relocating the culvert in Sand Coulee Creek with a backhoe and loader. Equipment and materials were mobilized to the site including a tracked excavator, motor grader, D7 dozer, 2 rubber tired scrapers, loader, backhoe, crane, dump truck, water truck, flatbed truck and fuel truck. The Contractor also mobilized an equipment trailer,

portable outhouse, and travel campers to house employees. The travel campers were located adjacent to the Centerville High School through an agreement with the school board. Equipment breakdowns were common, primarily involving the Case 980 excavator, JD 510 backhoe and a dump truck which tipped over.

Interceptor drains were installed on the upper east side slopes primarily using the excavator, backhoe, and dozer. Coversoil was removed prior to trench excavation and the location of the trenches were leveled with the dozer to provide access for the excavator. At first, coversoil was stockpiled on the down hill side of the trenches. This caused considerable mixing of subsoils and coversoil during the excavation and backfilling of the trenches. This method was changed, where possible, to place the coversoil uphill of the trench and place excavated subsoil on the downhill side of the trenches. On occasion, the trenches were excavated and the interceptor drains were placed in trenches but backfilled in the same day. In several instances, trench walls collapsed overnight and damaged the geocomposite material. To avoid this, trenches were partially backfilled prior to ending work for the day.

The filter fabric on the geocomposite was wrapped around the perforated pipe and attached using wire poked through both the filter fabric and geocomposite. This work was done above ground and adjacent to the trench. Pipe cleanouts and risers were also assembled above ground. This assembly work typically required 2 laborers. After assembly, the geocomposite/perforated pipe (geocomp/perf) and cleanout was lowered into the trench with the help of 2 to 5 laborers, depending on the length of interceptor installed. Again, trench caving limited the length of interceptor installed at one time to typically less than 50 feet. The interceptor drain assembly was held in place with 2x4 boards used as levers. The upper edge of the geocomposite was held up by temporarily attaching wire to the upper edge and hanging the geocomposite on a 2x4 board which spanned the trench.

Some of the trenches required additional tiers of geocomposite above the lower 4 foot high section attached to the perforated pipe. This need was identified during excavation because seepage water was observed emanating above the lower section of geocomposite. The attachment of additional geocomposite was accomplished in one of two ways. The need for an additional tier was identified prior to geocomp/perf assembly and in most cases the necessary additional section was attached with wire prior to installation in the trench. In some cases, the Contractor would install the lower tier of geocomp/perf, backfill the trench to near the top of the geocomposite then attach the next tier of geocomposite while in the trench. This second method was typically done when the trench was a shallow depth.

Backfilling of the interceptor drains was accomplished with either a dozer, backhoe, loader, or the excavator. The backhoe and excavator were better suited for careful and selective backfill placement, but for the sake of expediting backfilling the dozer or loader were often used. This method involved pushing backfill material into the trench and often resulted in tearing or folding the geocomposite. This method also caused considerable problems with collapsing or crushing of perforated pipe. The majority of trench backfilling work at the Centerville site was done with a backhoe and consequently no pipe required later repair at this site.

Exploratory excavation at Centerville "C" for the existing 4" PVC line for attachment to the interceptor drains was accomplished with the excavator. During the process of tying in the interceptors to the existing pipeline, a considerable amount of precipitate was found in the existing line. A work directive was issued to cleanout the existing line. This work was accomplished by CARP's Pipe Cleaners of Great Falls using a sewer jet.

Installation of the bentonite/soil seal at the down gradient end of the interceptor drains was accomplished with methods similar to grouting a well. An assembled wooden box built of form-ply was installed at the location required. The box dimensions were roughly the same as the trench width, as high as the highest tier of geocomposite and the required 8 inch thickness. The box also had a hole cut in the bottom to accommodate placement over the 4" PVC in the bottom of the trench. In some cases, the box was lined with plastic to facilitate later removal. After installation in the trench, the box was backfilled with excavated

spoils on the outside and filled with a mix of bentonite and soil. Pulling of the box was typically done with a backhoe and chain attached to the box assuring that the bentonite seal was not disturbed.

The excavator was also utilized to excavate the limestone trench at the site. After initial excavation, it was determined that the limestone trench was excavated to the wrong dimensions. This initial trench was later used for the placement of the bypass pipeline and an additional trench of the correct dimensions was installed.

Grubbing and coversoil salvage in the area of the Centerville "C" wetland cells began at this time with use of the scraper and motor grader. Clearing of the north channel started and the existing 12" PVC pipe was removed with the backhoe and D7 dozer. A previously installed french drain was encountered during interceptor drain installation. The new interceptor drain was installed to also intercept any water captured by the old french drain, but very little water was observed in the old french drain. Removal and salvage of existing fence was accomplished by hand labor and use of the backhoe to pull fence posts. The adit was closed with hand labor. The service hole locations were excavated and service holes placed with the backhoe and crane. Most of the basic interceptor drain systems were installed at Centerville during this period. Dewatering consisted of allowing for water to flow from interceptors to existing piping.

On the last three work days of this month the Stockett site was accessed and work began on the west slope interceptor drain installation and connections to the existing 4" PVC pipeline. Methods and equipment used were similar to those used at Centerville. Soil samples were taken at the wetland channel locations to verify bentonite application rates. At the same time the Contractor was mobilizing to Stockett, he was notified of a potential Change Order to increase wetland size at Centerville. AMRB personnel visited the site three times.

SEPTEMBER 1991 During this period 5 to 7 Sharbono employees were on the job, with an average of 6 men. Activities at the Centerville site included stockpiling or moving of construction materials and equipment. Bentonite/soil seal material was mixed at Centerville for placement at the end of Stockett interceptor drains. This mixing method entailed placing a measured quantity of soil and bentonite on a flat location spreading, folding with a blade, watering and loading with a loader, motor grader and dump truck.

Primary work activities during the month took place at the Stockett site. A tracked loader/dozer, JD 555, was mobilized to the job. Stockett activities were dominated by interceptor drain installation. The service holes were also located and placed. Methods were as described in August. Some service hole valves were installed. The Contractor identified his proposed imported coversoil source and soil samples were taken and sent for analysis. A small amount of fencing activity took place. Equipment breakdowns were common, primarily involving hydraulic problems with the Case 980 excavator.

The Contractor requested a change in the access road and fencing arrangement at Stockett. During trench excavation of the interceptor drains it was noted that the designed interceptor system would not likely intercept all the seepage water. Most seeps were able to be intercepted with one interceptor line installed at the top of the seep burned area; however, at some locations, predominantly at the northwest site slope it was determined that additional interceptors would need to be installed to catch the water missed by the uphill interceptor. The changes were discussed and agreed to by the affected landowner Dave Marko who was very cooperative. The changes were agreed to by AMRB and a field directive was issued to the Contractor to increase the interceptor drain quantities. At the Contractor's request and after Engineer review, he was given the option of changing limestone trench dimensions to better fit his equipment and materials sizes.

Water sampling was conducted by the Engineer to ascertain water quantity and quality changes of water intercepted. Centerville wetland design expansion was also conducted.

OCTOBER 1991 During this period 6 to 8 Sharbono employees were on the job, with an average of 7 men. Primary work activities included interceptor drain installation at the Stockett site and wetland

earthwork at the Centerville site. Equipment breakdowns were common, primarily involving hydraulic problems with the Case 980 excavator, a dump truck drive shaft, one of the scrapers and, the motor grader. AMRB personnel visited the site once.

At the Contractor's request and after Engineer review, he was given the option of changing limestone trench dimensions to better fit his equipment and materials sizes. The dimension size change also fit the site locations easier with no reduction in limestone aggregate treatment volume. Excavation of the Stockett limestone trenches were done by the 980 Case. Placement of the mixed bentonite/soil seal and limestone aggregate in the limestone trenches was done with the JD 555.

Dewatering of interceptor trenches on the Stockett site consisted of allowing for water to flow into existing piping. Another dewatering method involved water flowing out the end of the newly installed piping and into an excavated trench which was pumped into the water truck as necessary. The drawbacks to this method was that the trench would fill after weekends or weather days and cause saturated soil conditions.

The Contractor elected to begin hauling in imported coversoil to Stockett even though no liming had been done. This required later double handling of coversoil to lime areas under coversoil stockpiles. Coversoil was hauled with dump trucks.

The JD 555 began rough shaping of the north wetland channel at Stockett. Final grading of interceptor drain disturbances was done with the D7 dozer.

Work on the Centerville wetland began in earnest on October 14, 1991. The wetland earthwork was done with the two scrapers, the D7 dozer the motor grader and the backhoe. Some revision of the wetland shape was done to provide better access for construction on the east side of the wetland cells. This revision required additional fill material which was obtained from the slope north of the north channel and from the materials stockpile area. The water truck was also employed for compaction and dust control. By October 24, the wetland earthwork was done except for fine grading.

Weir outlet structures were installed using the backhoe, a loader and considerable hand labor. The wood post foundations for the weirs were pounded in with the backhoe bucket and cut with a chainsaw at the correct elevation. Soils below the weirs were compacted with the hand operated whackers. Insulation was cut to size and attached to the underside of the service hole tops prior to placement of the tops. Weather shutdown occurred the last week of October.

NOVEMBER 1991 Work efforts were hampered by bad weather conditions the first, second and last weeks of November, as well as the Thanksgiving holiday. During this period, 8 to 16 Sharbono employees were on the job, with an average of 10 men. Employee crew size was increased mid-month for about a week, with about half the crew at each of the two sites. Equipment breakdowns were common, primarily involving a dump truck and a backhoe. Additional equipment mobilized to the project included the tractors disks and tillers used for lime and bentonite incorporation.

Primary activities at Centerville included fine grading wetland cells with the JD 555 and excavation for the limestone trench and associated piping with the Case 980. After fine grading, bentonite placement began in the wetland cells. The bagged bentonite was placed by hand and incorporated with a tractor, with an attached roto-tiller. The bentonite placement method was labor intensive. Remaining weir structures were placed in the wetland.

Additional work at Centerville included excavation and installation of a fourth interceptor drain. This work was anticipated earlier but delayed to allow the earlier installed upper interceptors to help dewater the location of the fourth interceptor. The surface of this fourth interceptor was graded to also perform as the required slope terrace.

Lime application began at the Stockett site on November 14, 1991. The bagged lime was placed by hand and incorporated with a tractor and disk in tow. The limed areas were also ripped with the ripper teeth on either the motor grader or D7 dozer. The placement method chosen by the Contractor was very labor intensive but effective. The disk used for incorporation was not very large and did not have a working hydraulic lift hookup. This required multiple disk passes. Grading of the north wetland channel was done primarily with the JD 555. Part of the stockpiled coversoil was spread using the D7 dozer.

Because of the dewatering method at the Stockett site, and a winter shutdown eminent, a temporary installation of part of the piping at the NE limestone trench was required. Water samples were taken to help determine the final piping arrangement.

DECEMBER 1991 TO MARCH 1992 Winter shutdown.

MARCH 1992 During this period 7 to 12 Sharbono employees were on the job, with an average of 10. Additional subcontractor employees included a fencing crew of 2 and 1 imported coversoil hauler. Equipment breakdowns were common, primarily involving the JD 555, a ditch witch, a compactor, the Case 980 excavator, and a backhoe.

At the Centerville site primary activities involved excavation and installation of piping related to the limestone trench and wetland. This work was done by the Case 980 and a backhoe. Another primary work item included incorporation and compaction of the wetland cells bentonite/soil seal. Incorporation included both ripping with the motor grader teeth and tilling with the tractor mounted roto-tiller. This resulted in good incorporation but required additional fine grading after incorporation. The fine grading was done with the newly mobilized JD 450 dozer. This dozer was well suited for the work, being small and having an articulating blade. Compaction was obtained with the Essick compactor/vibrator. Precipitation provided most of the water required to meet the compaction specification.

Other work on the Centerville wetland included trenching for the liner key with a ditch witch. This method worked well except at corners where it was difficult to keep the ditch which on the line painted to note the correct elevation. On the outside corners of cell 2, additional backfilling and recompaction were necessary. One result of key trenching was that material excavated from the trench had a tendency to fall downslope into the wetland. Consequently, hand labor was required to clean the wetland cells of excess earth as well as to assure the trenches were deep enough prior to membrane liner installation.

The method used to prepare the limestone trenches at Centerville and later at Stockett was to build forms of plywood inside the excavated trench. These forms were built after the bentonite/soil seal was placed on the floor of the trench. The space between the forms and the trench wall was later filled with the mixed bentonite/soil seal using the JD 555.

A bentonite box broke upon removing it from the end of one of the interceptors at Centerville.
A nearby pipe cleanout also broke in the process. This later required re-excavation and reinstallation of the box and cleanout riser. One reason this occurred is because the D7 dozer was used to remove the box and not the backhoe, as had been used on most of the other box removals.

Work at Stockett primarily involved grading of the wetland channels with the D7 dozer, the backhoe, the JD 555 and the JD 450. Grade for the north wetland channel was largely in place but required considerable effort to remove rocks in the channel. For this the JD 555 was well suited. Grade on the west wetland channel was more difficult to achieve, because cut on the north end of the channel had to be used as fill on the south end. First the backhoe was used to get the channel to grade. The backhoe was unable to efficiently move the material from cut to fill location and created an unintended casting bank. A better choice of equipment would have been a dozer. The JD 450, the D7 dozer, the JD 555 and the backhoe were later employed to fix and shape the west channel as well as the final shaping of the north

wetland channel. The JD 450 was best suited for this work. On the west wetland channel bentonite was applied by hand and incorporated with a tiller. On the north wetland the same method was employed as well as some application of premixed bentonite/soil.

Holes for wood corner fence posts were excavated with a auger mounted on the front of a Bobcat. Forms were built for the limestone trenches. Piping related to the service holes and limestone trenches was installed.

APRIL 1992 During this period 9 to 12 Sharbono employees were on the job, with an average of 11. Additional subcontractor employees included the liner crew of up to 12 employees and a fencing crew of 1 to 3. Bolland Construction also started Schedule 2 work on April 30, 1992 with a crew of 6. Equipment breakdowns were common, primarily involving the JD 555, a ditch witch, a compactor, the Case 980 excavator, and a backhoe.

Excavation and preparation of the surface water collection basin at Centerville was done with a backhoe and hand compactors. Premixed bentonite/soil seal was used for the basin. Subsurface and surface water required collection here. Large boulders encountered during excavation required shifting of the collector basin.

The primary activity which occurred in April was the installation of the membrane liners at both Centerville and Stockett. The liner subcontractor was well prepared for quick and efficient installation of the liners. A scheduling problem occurred because the liner installer finished his portion of the work before Sharbono could prepare all the areas for installation. As the liner subcontractor is responsible for the liner warranty they were very strict in adherence to the specifications for surface preparation prior to liner placement. Other than hand tools and the seam testing equipment, the liner subcontractor used a forklift to transport the liner onto the prepared surface. This method worked well with the help of bags to hold up the sides of the key trenches where the forklift had to cross them for access.

After installation of the liner at Centerville, the cushion fabric was installed and the key trenches were filled by hand. The potential of wind lifting and ripping the liner required the quick placement of the filter gravel. The Contractor had obtained approval from the liner manufacturer to drive on the liner as designed, so the Contractor elected to place the wetland substrate materials (gravel and Peat) with loaders and grade it with dozers. An access pad into each wetland cell was made of the filter gravel material. The gravel was hauled by either dump truck or loader, depending on haul distance from the stockpile. When a dump truck was used, the driver would dump the load on the access pad where either a loader would pick up and place the gravel or a dozer would push the gravel where needed in the cell. Care was taken to assure an acceptable gravel layer was placed where equipment was driving. Cautions were issued by the Engineer to the Contractor to limit vehicle travel and erratic driving while in the wetland cells. Fine Grading of the gravel was best accomplished with the JD 450 dozer. Substantial gravel quantities were left on the wetland cell access pad side slopes. The methods used for stockpiling, placing and grading the gravel required handling the gravel material at least 5 times. The effect was additional reduction in placed volume and material waste. Perforated pipes for the cell underdrain system were installed in the wetland cells concurrently with gravel placement.

Liner key trenching of the wetland channels at the Stockett site proved to be difficult. This was because some locations were as steep as 2.5:1 making it difficult for the ditch witch to hold on the slope. In this situation the backhoe was chained to the ditch witch to hold it in place. Although requiring additional equipment, this method worked well. Numerous rocks were encountered during key trench excavation and hand labor was required to remove the rocks. The key trenches at the channel dams/baffles which are perpendicular to the channel slope, were installed by over-excavating the trench with a backhoe. After excavation the trenches were filled with bentonite/soil premix, compacted with the hand operated Whacker, and then re-excavated by hand to the dimension required. The design dimensions of these perpendicular key trenches were revised to better accommodate the backhoe bucket width. The Mikisa hand operated

model compactor/vibrator was utilized for most of the compaction of the wetland cell channels. It worked well in the small working area available.

An additional interceptor drain was installed at the north west end of the Stockett site in the vicinity of an existing telephone pole. This was found to be necessary to reduce uncontrolled seepage in the north wetland channel. Because of the elevation difference this intercepted water is unable to flow to either limestone trench and was routed directly to the north wetland channel. This "telephone pole" interceptor system was installed mostly with use of a backhoe.

Liner key trenches at the Stockett site were also backfilled by hand. The bags of gravel used to temporarily hold the liner in place in case of wind, were used as rip rap in the perpendicular key trenches. This was allowed rather than require removal and placement at the Centerville site. Hand placed rip rap was found on site and transported to each check dam with the JD 555.

Cleanout number 39 at Stockett was found to be leaking at the surface. After running a sewer tape down the cleanout the distance to the plug was found. The length of interceptor between cleanouts 39 and 40 was excavated and the perforated pipe was found to be collapsed. A length of geocomposite and pipe was replaced and backfilled with the D7 dozer. The cause of the collapsed pipe was speculated to be improper backfilling with rock and heavy clay clods.

After building the limestone trench form walls, the inlet and outlet pipe penetrations were cut in the forms. The Contractor requested that he be able to leave the forms in the trenches during backfilling. This was allowed but required that cushion fabric be placed between the membrane liner and the form-ply, not only between the liner and limestone aggregate as specified. The liner in the trenches was cut to size and seamed out of the trench from measurements of the trench forms. About 1 foot of extra length was included in the liner. After placement of the liner and cushion fabric, the bentonite seal and limestone were installed. It was found that to keep the forms from bending, about equal heights of limestone and bentonite had to be placed consecutively. The JD 555 and hand labor was used for this placement. The method worked well except at the corners of the trenches where short tears occurred in the liner and some gaps up to 4 inches occurred between the liner and the plywood. In order to assure a solid non-leaking tub, the gaps were filled with bentonite seal and tamped and the corner tears were patched.

Peat substrate products were placed in the Centerville wetland utilizing dump trucks, loaders, the JD 555, a Bobcat and the JD 450. The Contractor started by placing Peat in cell 1 with a loader and noticed early in the process that driving on the previously placed peat reduced its volume considerably. Loaders would place coversoil on the inside dike slopes concurrently with peat. Smoothing of the peat surface and mixing of the limestone aggregate was done with the JD 555 or JD 450. This was done in the cells and caused considerable compaction as evidenced by comparing the shipped volumes to measured in-place volumes.

The methods used for stockpiling, placing and grading the peat required handling the peat material at least 5 times. The effect was additional reduction in placed volume and material waste. Installation of the Peat-OM progressed with similar methods with the addition of hand labor to remove straw and hay bale twine. The Peat-OM is a mix of straw and hay with manure and the limestone aggregate. The mixing was done in place in wetland cell 2 and involved placing the different material types in alternating layers. Hay bale dikes were placed in the wetlands by hand labor and use of the JD 555.

Peat material placement at the Stockett site was done with the JD 555 and hand labor. After loading and hauling the peat from the Centerville site stockpile in dump trucks, the peat was mixed with the lime aggregate in the Stockett stockpiles. The JD 555 then picked up the material and accessed each wetland channel dam from the slope uphill of the wetland channel. The material was then dumped on a sheet of visquene, dragged by hand to the wetland channel, the visquene was pulled out and the peat was spread by hand. Although requiring many handling operations, this method worked well. Because of the wetland channel final grades, more material was placed in each of the west wetland channel cells than the north channel.

Watering of the peat at Centerville was done by utilizing the nearby Centennial Park well. A temporary pipeline was laid on the ground surface from the well to the wetland and sprinklers were attached. This worked well as a large quantity of water was required and was relatively easy to obtain. The initial filling of cell 1 resulted in excessive water. To allow proper cattail placement the cell water was pumped with a portable pump into cell 2.

Pipe cleanout assemblies required hand work to grade proper drainage, trim the riser pipes and, install the locking tab system with concrete. This took quite a long time to get all the cleanouts finished and some had to be repaired later when the tabs broke free from the concrete.

The JD 450 dozer was used to do the grading on the outside slopes of the Centerville wetland as well as the north drainage channel. Fencing took place at both the Centerville and Stockett sites.

Planting of the cattails began in Centerville wetland cell 1 on April 30, 1992. Bolland used hand labor and hand tools to do the work.

MAY 1992 During this period 10 to 11 Sharbono employees were on the job, with an average of 10. Bolland Construction's Schedule 2 work was done with a crew of 7 one day and 2 the next. Equipment breakdowns were common, primarily involving the JD 555.

Bolland completed planting cattails in cell 3 and did the tree transplanting work at the Centennial Park in two days. The tree transplanting required up to 4 laborers and use of a Case 580B backhoe. This tree transplanting was done efficiently and a pickup truck load of peat material was used from the wetland stockpile. Sharbono provided water for the cattails.

Placement of Peat-OM continued in cell 2 with hand labor help in finish grading. The finish grading work on the north channel at Centerville was done with the motor grader and the JD 450. The JD 450 and a competent operator provided a good final grading product at both the channel and the wetland dike side slopes. Topsoil thickness on the side slopes inside of the wetland dikes was found to be thin and required additional amounts to be placed.

The loaders were used to transport coversoil to the required locations and grading of the coversoil was done with either the loader, motor grader, or dozers. After additional soil sampling, it was determined that additional lime needed to be placed at some locations. As discussed earlier, the lime application rate varied over the site. The same methods were used as described earlier.

Additional pipe plugging problems at Stockett surfaced during this period. Water was again leaking out of cleanout 39 as well as cleanout 57. Improper backfilling was again found to be the problem at cleanout 39 and was repaired. During repair, the trench was left open overnight and the lesson learned earlier to fill the trench soon after interceptor placement had to learned again. Improper pipe installation causing precipitation of iron oxides was found to be the problem at cleanout 57. This pipe was repaired. By this time pipe installation methods had come into question and the decision was made to enforce a modified pipe testing method. This testing method involved utilizing either a sewer tape or sewer snake to assure no additional plugs existed.

Continuing work at Stockett included bypass pipe installation, peat and rip rap placement in the wetland channels and fencing. The loader or the JD 555 was used to haul the limestone aggregate to the small seep locations. Hand labor was later required to finish the grading of the aggregate. Sharbono conducted some private work off the project site during this period.

JUNE 1992 During this period 9 to 11 Sharbono employees were on the job, with an average of 10. Additional subcontractor employees included hydroseeding crew of 3 employees and a fencing crew of 2. Equipment breakdowns were common, primarily involving the Case 980, the seeding and mulching equipment and sewer snaking equipment. Rainy weather hampered work efforts during June.

At Centerville work continued on wetland cell 2 Peat-OM placement. Liming and seed bed preparation was done on the upper slopes. Lime incorporation included hand labor on the steep devegetated area No.1. Coversoil was spread with the D7 dozer. Erosion control mat was hand placed on the steep slope and north channel. The mat key trenches were excavated by hand. The seeding subcontractor hydroseeded the steep slopes and the wetland side slopes. An additional interceptor was placed north of the existing PVC line. The terrace on the steep slope required hand repair. Fencing was done on rainy days when access to either site was not feasible.

Primary activities at the Stockett site included pipe testing with the sewer snake, repair of plugged interceptor drains and, lime application. Seeding, fertilizing and mulching started late in June, using a disk, Brillion seeder, a Bowie mulcher and, a homemade crimper. The seeding, fertilizing and mulching equipment and method is standard on AMR projects. Results were variable largely due to weather conditions and equipment problems. Some areas adjacent to the wetland channels were hydromulched. Some seeding, fertilizing and mulching was done by hand on areas inaccessible to equipment.

Additional work which took place at Stockett included completion of the adit closures, spreading coversoil, fencing, and additional hand grading of the areas around the pipe cleanouts.

JULY 1992 During this period 4 to 11 Sharbono employees were on the job, with an average of 6. Bolland Construction's Schedule 2 work was done with a one day crew of 11 employees. Equipment breakdowns were common, primarily involving the seeding and mulching equipment.

Primary work activities at Centerville included installation of the stock tank and related appurtenances, seeding, fertilizing and mulching, and completing work in wetland cell 2. Realizing that the peat material was compacting during vehicle travel, the Contractor installed plywood ramps into cell 2 to place the last of the Peat-OM and haybale dikes. The Contractor cleaned out the surface water collection basin which had partially filled with eroded sediment. Work continued to complete the pipe cleanout assemblies. Other Centerville activities included fencing, rip rap placement in the north channel, low spot grading, watering of wetland cells, site cleanup, and punch list items. Bolland planted about half of the cell 2 cattails.

Primary work activities at Stockett included completion of the pipe cleanouts, seeding, fertilizing and mulching, fencing, site cleanup, and punch list items.

Sharbono also completed the Belt Subsidence site work during this period. To do the Belt work, Sharbono used a dump truck, a backhoe, and the JD 555. This work effort went quickly and smoothly.

AUGUST 1992 During this work period Sharbono was on site one day with 1 employee to take care of some punch list items and provide water for cattails. Bolland was at Centerville to finish planting cattails in cell 2 with 8 employees.

Bolland also completed the French Coulee repairs during this period. Two employees used a Case 580K backhoe and hand tools to efficiently complete the work.

4.4 Major Equipment List

Following is a list of the equipment used by the Contractors for the Cascade Mine Drainage project.

TABLE 3. Equipment List

TYPE	MAKE/MODEL	# ON PROJECT
Dozer with ripper teeth	D-7G CAT	1
Crawler Loader w/combo. loader/blade front	John Deere 555	1
Dozer w/7' articulating blade	John Deere 450G	1
Tracked Excavator	Case 980 B,1 CY Bucket	1
Front end loader (rubber tired)	950 CAT, 3.5 CY Bucket	1
Front end loader (rubber tired w/ bad brakes)	Michigan 75B Clark, 3.5 CY bucket	1
Belly scraper (rubber tired)	CAT 21 CY Cap.	2
Fork Lift	Clark	1
Backhoe w/ front end loader (rubber tired)	John Deere 510, 3/8 & 11/8 buckets	2
Backhoe w/ front end loader (rubber tired)	Case 580K	1
Backhoe w/ front end loader (rubber tired)	Case 580K	1
Crane	P&H 50 ton	1
Compactor (hand model)	Whacker	2
Compactor/vibrator (pull behind model)	Essick, w/Wisconsin Engine	1
Compactor/vibrator (hand model)	Mikasa, Dyna Pac	1
Compactor (backhoe mounted, not used)	John Deere	1
Water truck	Old model	1
Fuel Truck	International, 1600 gal. cap.	1
Flatbed truck	Ford F-600, 1 ton	1
Dump truck (orange)	GMC General, 12 CY cap.	1
Dump truck (red)	Kenworth, 10 CY cap.	1
Motorgrader with ripper teeth	CAT 12	1
Tractor w/ tiller & small front end loader	John Deere 52	1

TABLE 3. Equipment List

TYPE	MAKE/MODEL	# ON PROJECT
Tractor w/attachments •disk (no hydraulics) •crimper •seeder	Case 1470, 4x4	1
Seeder (pull behind)	Brillion	1
Flatbed truck w/mounted generator/welder	Chevy 2 ton	1
Hydromulcher	flatbed mounted	1
Mulch blower, flatbed mounted	Bowie Aero Mulcher, 40 H.P Wisconsin gas engine	1
Mulch Crimper	custom-built	1
Garden Tractor w/rear tiller	Montgomery Ward 12 H.P.	1
3/4 ton pickups	Ford	4
Fifth wheel trailer	misc.	3
Hand tools (shovels, picks & rakes)	Union	12
Chainsaw	Stihl	2
18 wheel Semi Transport rig	Kenworth	1
Fencing equipment (pliers, hammers, post pounders, post hole digger, spud bar)	misc.	2 sets
Rubber tired 4x4 utility tractor w/post hole auger	Bobcat	1
Rubber tired 4x4 utility tractor w/front end loader	Bobcat	1
Misc. hand tools (wrenches, screwdrivers, hammers, knives)	misc.	many
Liner equipment (pump, generator, hand rollers, air lance)	misc.	1 set
Survey equipment (level & rod)	misc.	1 set
Transplanting equip (shovels, rakes, spades)	misc.	1 set
Trencher	Ditch Witch, 7" wide	2
Sewer snake w/ attachments	100', misc.	3 different units
Generator (to run sewer snake)	5 to 10 H.P., misc.	4 different units
Sewer Tape	100', misc.	1

5.0 COST SUMMARY

This section of the report includes a listing of pay items and a summary of costs for each site.

5.1 Listing of Pay Items Including Quantities Used and Costs

The following Table 4 lists the payment items for both construction schedules. It includes quantities and costs and compares them to the project total cost and the original bids. For items which were added by change order or work directive, the comparison under "Percentage Change From Bid" refers to the comparison of the final cost to the cost estimated at the time of execution of the applicable change order or work directive change (WKDRCHG).

TABLE 4. Cascade Mine Drainage - Listing of Pay Items

Item #	Description	Unit	Final Approved Quantity	Final Unit Cost (dollars)	Final Total Cost per Item (dollars)	Percentage of Project Final Total Cost	Percentage of Orig. Bid (100% = no change)
1	Mobilization	LS	1	10,000.00	10,000.00	1.38	100.00
2	Access	LS	1	12,880.00	12,880.00	1.77	100.00
3	Dewatering	LS	1	9,844.00	9,844.00	1.35	100.00
4	Earthwork	LS	1	49,025.00	49,025.00	6.74	156.00
5	Fine Grading	LS	1	3,546.90	3,546.90	0.49	100.00
6	Bentonite Seal	SF	71444	0.39	27,863.16	3.83	120.05
7	M. Liner - PVC	SF	63005	0.49	30,872.45	4.25	110.34
8	M. Liner - Hypalon	SF	23710	1.40	33,194.00	4.56	121.09
9	Filter Gravel	CY	1784	0.80	35,680.00	4.91	120.95
10	Peat	CY	1440.31	35.00	50,410.85	6.93	102.37
11	Peat-DCW	CY	1076.08	35.00	37,662.80	5.18	101.04
12	Hay Bale Dikes	EA	506	5.00	2,530.00	0.35	168.67
13	Lime Application	AC	12.6	1,800.00	22,680.00	3.12	252.00
14	Stock Tank-1000 Gal	EA	1	2,500.00	2,500.00	0.34	100.00
15	Weir Outlet Str.	EA	1	800.00	3,200.00	0.44	133.33
16	Geocomposite	SF	22485	1.25	28,106.25	3.86	204.41
17	Drain Pipe, 4" PVC	LF	5526	8.00	44,208.00	6.08	100.00
18	Perforated Pipe, 4"	LF	3376	9.00	30,384.00	4.18	118.04
19	18" PE Culvert	LF	20	40.00	800.00	0.11	100.00

*New Item by Change Order

TABLE 4. CASCADE MINE DRAINAGE - LISTING OF PAY ITEMS

Item #	Description	Unit	Final Approved Quantity	Final Unit Cost (dollars)	Final Total Cost per Item (dollars)	Percentage of Project Final Total Cost	Percentage of Orig. Bid (100% = no change)
20	Drain Pipe Concrete Anchors	EA	3	100.00	300.00	0.04	8.82
21	Pipe Cleanout Assembly	EA	88	75.00	6,600.00	0.81	137.50
22	Appurtenance, 4" Type 1	EA	53	88.00	4,664.00	0.64	100.00
23	Appurtenance, 4" Type 2	EA	164	86.00	14,104.00	1.64	160.78
24	PVC Valves, 4"	EA	10	280.00	2,800.00	0.39	100.00
25	Service Holes, 72"	EA	4	2,790.00	11,160.00	1.53	100.00
26	Limestone Aggregate	CY	270	15.00	1,500.00	0.56	100.00
27	Cushion Fabric	SY	7545	2.85	21,503.25	2.96	110.63
28	Riprap	CY	42.5	40.00	1,700.00	0.23	81.73
29	Close Mine Opening-Adit	EA	3	750.00	2,250.00	0.31	150.00
30	Import Coversoil	CY	3080	6.50	20,020.00	2.75	100.00
31	Fertilize & Seed	AC	15.5	950.00	14,725.00	2.02	193.75
32	Mulch	AC	15.5	650.00	10,075.00	1.39	193.75
33	Remove & Salvage Fence	LF	5100	0.35	1,785.00	0.25	100.00
34	Farm Fence-Type F4M	LF	7550	2.30	17,365.00	2.39	117.60
35	Farm Fence Gate, 16'	EA	12	70.00	840.00	0.12	80.00
36	Farm Fence Type F5M	LF	4480	2.40	10,752.00	1.48	100.00
37	Erosion Control Mat - Vinyl	SY	200	7.50	1,500.00	0.21	100.00
38	Erosion Control Mat - Bio	SY	1020	5.25	5,355.00	0.74	44.35
39 *	Peat-OM	CY	4245	20.00	84,900.00	11.67	178.74
40 *	Limestone Agg. Mix w/Peat	CY	247	20.00	4,940.00	0.68	

TABLE 4. CASCADE MINE DRAINAGE - LISTING OF PAY ITEMS

Item #	Description	Unit	Final Approved Quantity	Final Unit Cost (dollars)	Final Total Cost per Item (dollars)	Percentage of Project Final Total Cost	Percentage of Orig. Bid (100% = no change)
41 *	SCH1 WKDRCHG 1 - Clean Exist Pipe	LF	275	1.70	467.50	0.06	93.56
42 *	SCH1 WKDRCHG 2 - Hand Close Adit	LS	1	3,000.00	467.50	0.41	91.67
43 *	SCH1 WKDRCHG 3 - Close Belt Subsidence	LS	1	4,865.00	4,865.00	0.67	100.00
44 *	Extra Labor item #13	LS	1	12,500.00	12,500.00	1.72	100.00
45	Mobilization	LS	1	1000.00	1,000.00	0.14	100.00
46	Transplant Wetland Vegetation	SF	44600	0.45	20,070.00	2.76	122.19
47	Transplant Trees	EA	25	235.00	5,875.00	0.81	100.00
48 *	SCH2 WKDRCHG 1 - French Coulee	LS	1	2710.00	2,710.00	0.37	100.00
	TOTAL BOTH SCHEDULES				**727,263.16**	100.02	133.42

*New Item by Change Order or DSL Correspondence

5.2 Summary of Costs

Schedule 1, Final Payment Request No. 7, resulted in a net overall increase of $214,150.16 and Schedule 2, Final Payment Request No. 2, resulted in a net overall decrease of $31,970.00. Combined these result in a total contract price of $727,263.16. This equates to a 133.42% increase in project cost over that originally bid for the two schedules. Following narratives in this section are item cost breakdowns as required by the AMRB.

The total cost **per acre** for the Cascade Mine Drainage project was approximately $46,920.20 per acre based on a project size of 15.5 acres and a total contract amount of $727,263.16. If only the applicable bid items of lime application, import coversoil, fertilize and seed, mulch, remove and salvage fence, and farm fence type F4M are included, the per acre cost is about $ 6396.50.

The total cost **per cubic yard** for the Cascade Mine Drainage project was approximately $102.43 per cubic yard based on a total of 7100 cubic yards of excavation and a total contract amount of $727,263.16. If only the earthwork bid item is included, the cost per cubic yard is $6.90.

The total cost **per mine closure** for the Cascade Mine Drainage project was approximately $145,452.63 per closure based on a total of 5 closures and a total contract amount of $727,263.16. If only the applicable items of Close Mine Openings - Adit, Hand Close Adit and Close Belt Subsidence are included, the per closure cost amounts to $ 2023.00.

The total cost **per wetland acre** for the Cascade Mine Drainage project was approximately $559,433.20 per wetland acre based on a project wetland size of 1.3 acres and total a contract amount of $727,263.16. If only the directly applicable items of Earthwork (80%), Fine Grading, Bentonite Seal (90%), Membrane Liner - PVC (90%), Membrane Liner - Hypalon, Filter Gravel, Peat, Peat-DCW, Hay Bale Dikes, Stock Tank, Weir Outlet Structure, Cushion Fabric, Farm Fence Gate, Farm Fence Type F5M, Peat-OM, Limestone Aggregate Mix with Peat and Transplant Wetland Vegetation are included the per wetland acre cost amounts to $ 241,859.00 **(prior to final pay request).**

The total cost **per limestone trench** for the Cascade Mine Drainage project was approximately $242,421.05 per limestone trench based on a project number of 3 limestone trenches and a total contract amount of $727,263.16. If only the applicable bid items of Earthwork (5%), Bentonite Seal (10%), Membrane Liner - PVC (10%), and Limestone Aggregate are included, the per limestone trench cost amounts to $ 4,124.94.

The total cost **per lineal feet of interceptor drain** for the Cascade Mine Drainage project was approximately $229.71 per lineal feet of interceptor trench based on a project amount of 3166 lineal feet and a total contract amount of $727,263.16. If only the directly applicable items of Dewatering, Earthwork (15%), Geocomposite, Drain Pipe, Perforated Pipe, Drain Pipe Concrete Anchors, Pipe Cleanout Assembly, Appurtenance Type 1, Appurtenance Type 2, PVC Valves, Service Holes, and Clean Existing Pipes are included, the per lineal foot cost is about $ 50.00.

The total cost for the two project sites in Centerville and Stockett are broken down in the following Table 5.

TABLE 5. Site Breakdown - Stockett SE & Centerville "C"

Item #	Description	Unit	Final Approved Quantity - Centerville	Final Approved Quantity - Stockett	Final Unit Cost (dollars)	Final Cost per Item - Centerville (dollars)	Final Cost per Item - Stockett (dollars)	Final Cost per Item - Both Sites (dollars)
1 **	Mobilization	LS	.917	.083	10,000.00	9,170.00	830.00	12,000.00
2 **	Access	LS	.391	.609	12,880.00	5,036.08	7,843.92	12,880.00
3 **	Dewatering	LS	.349	.651	9,844.00	3,435.56	6,408.44	9,844.00
4 **	Earthwork	LS	.818	.182	49,025.00	40,102.45	8,922.55	49,025.00
5 **	Fine Grading	LS	.789	.211	3,546.90	2,798.50	748.40	3,546.90
6	Bentonite Seal	SF	55974	15470	0.39	21,829.86	6,033.30	27,863.16
8	M. Liner - PVC	SF	58645	4360	1.49	28,736.05	2,136.40	30,872.45
8	M. Liner - Hypalon	SF	.780	22950	1.40	1,064.00	32,130.00	33,194.00
9	Filter Gravel	CY	1784	0	20.00	35,680.00	0.00	35,680.00
10	Peat	CY	1440.31	0	5.00	50,410.85	0.00	50,410.85
11	Peat-DCW	CY	1014.58	61.5	9.00	35,510.30	2,152.50	37,662.80
12	Hay Bale Dikes	EA	506	0	5.00	2,530.00	0.00	2,530.00
19	Lime Application	AC	1.6	11	1,800.00	2,880.00	19,800.00	22,680.00
14	Stock Tank-1000 Gal	EA	1	0	2,500.00	2,500.00	0.00	2,500.00
16	Weir Outlet Str.	EA	4	0	1,800.00	3,200.00	0.00	3,200.00
16	Geocomposite	SF	4478	18007	1.25	5,597.50	22,508.75	28,106.25
17	Drain Pipe, 4" PVC	LF	2476	3050	8.00	19,808.00	24,400.00	44,208.00
18	Perforated Pipe, 4"	LF	895	2481	9.00	8,055.00	22,329.00	30,384.00
19	18" PE Culvert	LF	20	0	40.00	800.00	0.00	800.00
20	Drain Pipe Concrete Anchors	EA	3	0	100.00	300.00	0.00	300.00
21	Pipe Cleanout Assembly	EA	27	61	75.00	2,025.00	4,575.00	6,600.00
22	Appurtenance, 4" Type 1	EA	27	6	88.00	2,376.00	2,288.00	4,664.00
23	Appurtenance, 4" Type 2	EA	79	85	86.00	6,794.00	7,310.00	14,104.00
24	PVC Valves, 4"	EA	5	5	280.00	1,400.00	1,400.00	2,800.00
25	Service Holes, 72"	EA	2	2	2,790.00	5,580.00	5,580.00	11,160.00

* New Item by Change Order
** Decimal % of Lump Sum from Contractor's Schedule of Values

TABLE 5. SITE BREAKDOWN - STOCKETT SE & CENTERVILLE "C"

Item #	Description	Unit	Final Approved Quantity - Centerville	Final Approved Quantity - Stockett	Final Unit Cost (dollars)	Final Cost per Item - Centerville (dollars)	Final Cost per Item - Stockett (dollars)	Final Cost per Item - Both Sites (dollars)
26	Limestone Aggregate	CY	90	180	15.00	1,350.00	2,700.00	4,050.00
27	Cushion Fabric	SY	6649	896	2.85	18,949.65	2,553.60	21,503.25
28	Riprap	CY	6	36.5	40.00	240.00	1,460.00	1,700.00
29	Close Mine Opening-Adit	EA	1	2	750.00	750.00	1,500.00	2,250.00
30	Import Coversoil	CY	900	2180	40.00	5,850.00	14,170.00	20,020.00
31	Fertilize & Seed	AC	3.8	11.7	950.00	3,610.00	11,115.00	14,725.00
32	Mulch	AC	3.8	11.7	650.00	2,470.00	7,605.00	10,075.00
33	Remove & Salvage Fence	LF	4000	1100	0.35	1,400.00	385.00	1,785.00
34	Farm Fence-Type F4M	LF	2525	5025	2.30	5,807.50	11,557.50	17,365.00
36	Farm Fence Gate, 16'	EA	5	0	70.00	350.00	490.00	840.00
38	Farm Fence Type F5M	LF	1620	2880	2.40	3,840.00	6,912.00	10,752.00
37	Erosion Control Mat - Bio	SY	200	0	7.50	1,500.00	0.00	1,500.00
38	Erosion Control Mat - Bio	SY	1020	0	5.25	5,355.00	0.00	5,355.00
39 *	Peat-OM	CY	4245	0	20.00	84,900.00	0.00	84,900.00
40 *	Limestone Agg. Mix w/Peat	CY	237	10	20.00	4,740.00	200.00	4,940.00
41 *	SCH1 WKDRCHG 1 - Clean Exist Pipe	LF	275	0	1.70	467.50	0.00	3,000.00
42 *	SCH1 WKDRCHG 2 - Hand Close Adit	LS	1	0	3,000.00	3,000.00	0.00	3,000.00
40 *	Extra Labor Item #13	LS	0	1	12,500.00	0.00	12,500.00	12,500.00
44	Mobilization	LS	1	0	1000.00	1,000.00	0.00	1,000.00
45	Transplant Wetland Vegetation	SF	800	43800	0.45	360.00	19,710.00	20,070.00
46	Transplant Trees	EA	25	0	235.00	5,875.00	0.00	5,875.00
	TOTAL BOTH SCHEDULES					**449,433.80**	**270,254.36**	719,688.16

* New Item by Change Order or DSL Correspondence

** Decimal % of Lump Sum from Contractor's Schedule of Values

The total cost for the work at the Belt Subsidence site was $4865.00. Following is a breakdown of the contractor's quote which was used in obtaining the lump sum cost.

Mobilization	1000.00
Exploratory Excavation	350.00
Provide Backfill	2700.00
Salvage Coversoil	350.00
Fertilize, Seed & Mulch	465.00
TOTAL	$4865.00

The total cost for the work at the French Coulee site was $2710.00. Following is a breakdown of the contractor's quote which was used in obtaining the lump sum cost. Mobilization was included in the item costs.

Modify 6" Clay Pipe	975.00
Install 8" PVC Valve	1635.00
Repair Riser Cleanout	100.00
TOTAL	$2710.00

The Consultant costs incurred for site investigation, design and construction management totaled about $204,428.51 for the project. This amount is 28.11% of the total construction costs. The construction engineering cost compared to construction can be attributed to several factors including: 1) the construction period lasting considerably longer than necessary or expected 2) the considerable amount of effort expended to evaluate the contractor's claim for additional payment 3) the scope of the project was increased during construction with these design costs included as construction costs. The analysis of construction and engineering costs is presented in Attachment E.

A cost breakdown of the other lump sum bid items follows.

Description	Total Cost	Quantity	Cost per Unit
Mobilization, SCH1 & 2	$11,000.00	15.5 acres	$ 709.68/acre
Access	$12,880.00	15.5 acres	$ 830.97/acre
Dewatering	$ 9,844.00	15.5 acres	$ 635.10/acre
Site Earthwork	$49,025.00	7100 cu yds	$ 6.90/cu yd
Fine Grading	$ 3,546.90	1.9 acres	$ 1866.79/acre
Mobilization, SCH2	$ 1000.00	44600 sq ft	$ 0.022/sq ft of wetland plants

6.0 PROJECT SUMMARY

Schedule 1 of the Cascade Mine Drainage project was awarded to Sharbono Construction, Inc., of Helena, Montana on June 26, 1991. Schedule 2 of the Cascade Mine Drainage project was awarded to Bolland Construction, Inc., of Great Falls, Montana on July 12, 1991. Construction of the project began on August 1, 1991 and proceeded until Substantial Completion on July 23, 1992 (Schedule 1) and August 12, 1992 for Schedule 2. Final payment of Schedule 1 was January 25, 1993. Final completion and approval of Schedule 2 was September 21, 1992.

The primary intent of the reclamation design at the Centerville and Stockett sites was to revegetate the acidified soils, to intercept subsurface mine drainage to prevent additional soil acidification, and to demonstrate experimental acid mine drainage treatment methods. These treatment methods included ALD's and wetlands. These goals were accomplished in a considerably longer time period than expected.

6.1 Site Conditions after Completion

Upon completion of the project, the site was judged to be acceptable (Certificate of Substantial Completion was signed by all parties) but not in excellent shape. A primary reason for this condition was that the finai stages of fertilizing, seeding and mulching were not completed until mid-summer. The project general earthwork looked good. Items which delayed the issuance of the Certificate of Acceptance included punch list items attached to the Certificate of Substantial Completion, lack of the membrane liner warranty and a manhole at Centerville which was not draining properly.

In September, 1992, some erosion was evident on the Stockett site. This originated from an un-reclaimed area above the project construction boundary. Some sedimentation of the north wetland channel at Stockett was noted. This is expected to stabilize as the vegetation becomes established on the large construction disturbed area uphill.

In September, 1992, Cattails in the Centerville wetland cells 1 and 3 looked good, while cell 2 cattails were still struggling to emerge due to their planting late in the project. Cattails at Stockett were in poor condition with few growing. This is most likely attributed to the extremely acidic and undiluted mine drainage water at the site. The trees transplanted at Centerville Centennial Park were in good condition with only one of the 25 observed to be less healthy than the rest. The park committee, with help from the local volunteer fire department is following a recommended watering and maintenance plan on the trees.

Prior to, during and after construction, some noxious weeds were evident at all sites. Knapweed was present in large amounts at the Stockett and French Coulee sites while Leafy Spurge was present in large amounts at the Centerville and Stockett sites. A small amount of Knapweed was found near the Centerville and Belt Subsidence sites. The county weed district sprayed the knapweed patches at the Stockett site.

Please refer to the Record Drawings in Attachment G and the Operation and Maintenance Plan (Attachment F) for more detail.

6.2 Maintenance and Follow-Up

There are several items which should be considered during the 11th month Warranty Inspection. The membrane liner key trenches, liner and liner penetrations should be inspected to assure that they are working properly and that excessive erosion has not undermined the liner. The key trenches, erosion control mat and staples in the mat-lined channel should be inspected to insure that the mat is providing adequate protection from erosion in the channels and on the Centerville site steep slope.

The locations where piping was buried should be inspected for subsidence and seepage. All areas of vegetation planting should be inspected to assure adequate vegetation establishment. The project sites especially the steeper slopes should be inspected for excessive erosion. Weed growth should be examined to determine if additional weed control measures are necessary. General site fencing (Type F4M) should remain in place for a minimum of three years to assure vegetation establishment. Wetland site fencing (Type F5M) should be routinely checked and repaired as necessary to protect the wetlands from damage by cattle or vehicles.

Additional maintenance recommendations for the mine drainage control and treatment system are included in the Operation and Maintenance Plan (Attachment F) of this report.

6.3 Comments and Suggestions

The Cascade Mine Drainage project was executed and completed, but not without experiencing some problems. Sharbono Construction was innovative in their construction methods, but were oftentimes undermanned given time constraints and amount of work. Sharbono encountered difficulties due to equipment breakdowns, equipment type restrictions, supervision inadequacies, ineffective scheduling and, work force unproductiveness. In contrast, Bolland Construction was satisfactorily prepared with equipment and a well supervised work force to perform the tasks required for completion of Schedule 2 of the contract.

Some of the problems that occurred during the project can be attributed to the changes in the specifications of the contract as well as changes in the project scope and size. For example, additional materials had to be ordered to accommodate the additional interceptor drain systems installed and increased limed areas. Because the Centerville wetland size increase was not finalized until October 3, 1991, a delay of the wetland construction was created. The Contractor was unable, until mid-October, to mobilize additional crews to work at both Stockett and Centerville. Given the 51 day time extension granted in the fall, these wetland changes probably did not have an effect on the total contract time overrun.

Improper backfilling of the interceptor drains caused both a time and materials problem. Over 150 feet of perforated pipe and 700 square feet of geocomposite had to be replaced due to blockages in the pipe. Field observation identified that the blockages were invariably caused by sections of perforated pipe which were crushed during backfilling. Replacement of the pipe required 11 days work effort for at least two men.

The Contractor's chosen methods of wetland substrate placement were different than specified. The Contractor's method attributed to the considerable final material quantity discrepancies.

The design of a project requires insight to common problems which occur during construction, all of which cannot be anticipated. In order to facilitate some of the problems which occurred during this project, certain specifications and details on the plans could have been more specific. In particular, survey and exact locations and elevations of piping and wetland shapes. Rather than reduce costs at the design stage by use of existing topography mapping generated from air photography we recommend that for future projects of this nature that detailed land based topography surveys be used for design.

For a project of this type where design of one portion of the project (ALD's & wetlands) is dependant upon the findings of another portion of the project (water quality and quantity intercepted), serious consideration should be given to breaking the project into two parts. The seep collection and control portion of the project could be constructed well in advance so that the quantity and quality analysis results could be analyzed to fine tune the ALD and wetland design. This would reduce the potential of having to conduct site design during construction, as occured in this project.

The AMRB should consider amending some standard Technical Specifications and update them for current product types available. From the experience gained on this project, the following Technical Specifications

should be amended: 530.00, Riprap; 340.00, Erosion Control Mat; 561, Flexible Membrane Liner and; 650.00, Construction Fabric.

Attachment A. Bid Tabulations and Miscellaneous Administrative Forms

NOTICE OF AWARD

TO: Del Sharbono
Sharbono Construction
1826 North Main
Helena, MT 59601

DATE: June 26, 1991
PROJECT: Cascade Mine Drainage, Schedule 1
MONT A/E or DSL-AMRB: 91-001

PROJECT DESCRIPTION: Providing all labor, materials, earthwork & incidental to excavate and install trench drains, wetland mine drainage treatment systems, limestone trenches, and associated piping systems; close an adit

The Owner has considered the Bid submitted by you for the above-described Work in response to its Invitation for Bid dated June 13, 1991 and Instructions to Bidders.

You are hereby notified that your bid has been accepted for items in the amount of $483,458.00.

You are required by the Instructions to Bidders to execute the Agreement and furnish the required Contractor's Performance Bond, Labor and Material Bond, and Certificates of Insurance within 15 calendar days from the date of this Notice to you.

If you fail to execute said Agreement and to furnish said Bonds and Insurance within 15 days from the date of this Notice, said Owner will be entitled to consider all your rights arising out of the Owner's acceptance of your Bid as abandoned and as forfeiture of your Bid Bond. The Owner will be entitled to such other rights as may be granted by law.

You are required to return an acknowledged copy of this Notice of Award to the Owner.

Dated 27th day of June, 1991.

OWNER: DEPARTMENT OF STATE LANDS

By: Larry Marshall
Title: Bureau Chief

ACCEPTANCE OF NOTICE OF AWARD

Receipt of the above Notice of Award is hereby acknowledged this 2 day of JULY, 1991.

CONTRACTOR: Delbert D. Sharbono

By: Delbert D. Sharbono
Title: President

Rev. 3/91

RECEIVED
JUL 17 1991
STATE LANDS

NOTICE OF AWARD

TO: Boland Construction, Inc
2608 9th Avenue North
Great Falls, MT 59401

DATE: July 12
PROJECT: Cascade Mine Drainage
Schedule 2
MONT A/E or DSL-AMRB: 91-001

PROJECT DESCRIPTION: Vegetation at the Cascade Mine Drainage sites

The Owner has considered the Bid submitted by you for the above-described Work in response to its Invitation for Bid dated June 13, 1991 and Instructions to Bidders.

You are hereby notified that your bid has been accepted for items in the amount of $61,625.00.

You are required by the Instructions to Bidders to execute the Agreement and furnish the required Contractor's Performance Bond, Labor and Material Bond, and Certificates of Insurance within 15 calendar days from the date of this Notice to you.

If you fail to execute said Agreement and to furnish said Bonds and Insurance within 15 days from the date of this Notice, said Owner will be entitled to consider all your rights arising out of the Owner's acceptance of your Bid as abandoned and as forfeiture of your Bid Bond. The Owner will be entitled to such other rights as may be granted by law.

You are required to return an acknowledged copy of this Notice of Award to the Owner.

Dated 12th day of July, 1991.

OWNER: DEPARTMENT OF STATE LANDS

By: Larry Marshall
Title: Bureau Chief

ACCEPTANCE OF NOTICE OF AWARD

Receipt of the above Notice of Award is hereby acknowledged this 16 day of JULY, 1991.

CONTRACTOR: ED BOLAND CONSTRUCTION INC

By: Ed Boland
Title: PRESIDENT

Rev. 3/91

AGREEMENT

STATE OF MONTANA
DEPARTMENT OF STATE LANDS

FORM OF AGREEMENT BETWEEN CONTRACTOR AND OWNER

This Agreement made on July 29, 1991, between SHARBONO CONSTRUCTION, INC., hereinafter called the "Contractor", and the STATE OF MONTANA, acting by and through the Commissioner DEPARTMENT OF STATE LANDS, hereinafter called the "Owner".

WITNESSETH, that the Contractor and the Owner for the consideration hereinafter named agree as follows:

ARTICLE 1. SCOPE OF WORK

The Contractor shall furnish all the materials and perform all of the work for the SCHEDULE 1 portion of the Contract as shown on the Drawings and described in the Specifications entitled CASCADE MINE DRAINAGE Project, Mont A/E or DSL-AMRB 91-001, and shall do everything required by the Contract Documents.

ARTICLE 2. TIME OF COMPLETION

The work to be performed under this Contract shall be commenced on or before a date set forth by the Owner in a written "Notice to Proceed" and shall be completed within 90 calendar days.

Liquidated damages are Four Hundred Dollars ($400.00) per calendar day.

ARTICLE 3. THE CONTRACT SUM

The Owner shall pay the Contractor for the performance of the Contract, subject to additions and deductions provided, in current funds as follows:

Four hundred eighty three thousand, four hundred fifty eight dollars and no cents ($483,458.00)

ARTICLE 4. PROGRESS PAYMENTS

The Owner shall make payments on account of the Contract as follows: 90% of the value, based on the Contract prices of labor and materials incorporated in the work and of materials suitably stored at the project site or at some other location agreed upon in writing, up to the last day of the month, less the aggregate of the previous payments.

ARTICLE 5. ACCEPTANCE AND FINAL PAYMENT

Final payment shall be due 30 days after completion and acceptance of the work, provided the work is fully completed and the Contract is fully performed. Upon receipt of written notice that the work is ready for final inspection and acceptance, the Owner shall promptly make his inspection(s); and when he finds the work acceptable under the Contract and the Contract fully performed, he shall promptly issue a Certificate of Acceptance, over his own signature, stating the work provided for in this Contract has been completed and is acceptable by him under its terms and conditions and that the entire balance found to be due the Contractor and noted in the final certificate is due and payable.

Before issuance of a final certificate, the Contractor shall submit evidence satisfactory to the Owner that all payrolls, materials bills, and other indebtedness connected with the work have been paid. If the work has been substantially completed and the Owner certifies that full completion thereof is materially delayed through no fault of the Contractor, the Owner shall, without terminating the Contract, make payment of the balance due

for the portion of the work fully completed and accepted. Payment shall be made under the terms and conditions governing final payment, except that it shall not constitute a waiver of claims.

ARTICLE 6. NO DAMAGES FOR DELAY - OTHER CONTRACTORS

It shall be the affirmative duty of each and every Contractor on the project to cooperate and coordinate the scheduling and progress of its work with that of all other Contractors. Under no circumstances shall the State of Montana be liable for any damages for delay caused by the acts or omissions of another Contractor, and each Contractor expressly consents to suit by other Contractors for each and every claim for delay by said Contractors performing work on the aforementioned project. It is further stipulated and agreed that the terms of this provision shall govern over any other Contract document as defined in Article 7, infra.

ARTICLE 7. THE CONTRACT DOCUMENTS

The Bid Documents, together with this Agreement, form the Contract; and they are as totally a part of the Contract as if hereto attached or herein repeated. The following is an enumeration of the Contract Documents:

Invitation for Bid, Instructions to Bidders, Landowner/Contact List, Proposal, Bid Bond, Certification of Nonsegregated Facilities, Notice of Award, Agreement, Performance Bond, Labor and Material Bond, Insurance Certificates, Consent of Surety, Notice to Proceed, Work Directive Change, Change Order, Affidavit on Behalf of Contractor, Approval of Subcontractors, Substitution Request Form, Schedule of Values, Payment Request, Schedule of Materials, Contractor's Certificate of Completion, Certificate of Substantial Completion, Certificate of Acceptance, Standard Specifications for Abandoned Mine Reclamation Construction (General Conditions, Supplementary Conditions, Technical Specifications), Special Provisions, Drawings, and Wage Rates.

ARTICLE 8. STANDARD PREVAILING RATE OF WAGES AND PREFERENCE OF MONTANA LABOR

The Contractor and Subcontractors shall pay the current Montana Prevailing Wage Rates, including fringe benefits for health and welfare and pension contributions and travel allowance provisions in effect and applicable to the county or locality in which the work is being performed. These prevailing wage rates will be in accordance with the most current determination including applicable modifications and will be attached to the Specifications and are incorporated herein.

ARTICLE 9. VENUE

In the event of litigation concerning the Contract, venue shall be the First Judicial District in and for the County of Lewis and Clark, Montana, and the agreement shall be interpreted according to the laws of Montana.

WHEREOF the parties hereto have executed this Agreement, the day and year first above written.

STATE OF MONTANA DEPARTMENT OF STATE LANDS	Delbert Sharbono
Owner	Contractor
2nd Dennis D. Casey	Delbert D. Sharbono
Commissioner	(Signature)
	President
	(Typed/Printed Name and Title)
7-29-91	July 3, 1991
Date	Date

AGREEMENT

STATE OF MONTANA
DEPARTMENT OF STATE LANDS

FORM OF AGREEMENT BETWEEN CONTRACTOR AND OWNER

This Agreement made on August 26, 1991, between BOLAND CONSTRUCTION, INC., hereinafter called the "Contractor", and the STATE OF MONTANA, acting by and through the Commissioner DEPARTMENT OF STATE LANDS, hereinafter called the "Owner".

WITNESSETH, that the Contractor and the Owner for the consideration hereinafter named agree as follows:

ARTICLE 1. SCOPE OF WORK

The Contractor shall furnish all the materials and perform all of the work for the SCHEDULE 2 portion of the Contract as shown on the Drawings and described in the Specifications entitled CASCADE MINE DRAINAGE Project, SCHEDULE 2, Mont A/E or DSL-AMRB 91-001, and shall do everything required by the Contract Documents.

ARTICLE 2. TIME OF COMPLETION

The work to be performed under this Contract shall be commenced on or before a date set forth by the Owner in a written "Notice to Proceed" and shall be completed within 90 calendar days.

Liquidated damages are Four Hundred Dollars ($400.00) per calendar day.

ARTICLE 3. THE CONTRACT SUM

The Owner shall pay the Contractor for the performance of the Contract, subject to additions and deductions provided, in current funds as follows:

Sixty one thousand, six hundred twenty five dollars and no cents ($61,625.00)

ARTICLE 4. PROGRESS PAYMENTS

The Owner shall make payments on account of the Contract as follows: 90% of the value, based on the Contract prices of labor and materials incorporated in the work and of materials suitably stored at the project site or at some other location agreed upon in writing, up to the last day of the month, less the aggregate of the previous payments.

ARTICLE 5. ACCEPTANCE AND FINAL PAYMENT

Final payment shall be due 30 days after completion and acceptance of the work, provided the work is fully completed and the Contract is fully performed. Upon receipt of written notice that the work is ready for final inspection and acceptance, the Owner shall promptly make his inspection(s); and when he finds the work acceptable under the Contract and the Contract fully performed, he shall promptly issue a Certificate of Acceptance, over his own signature, stating the work provided for in this Contract has been completed and is acceptable by him under its terms and conditions and that the entire balance found to be due the Contractor and noted in the final certificate is due and payable.

Before issuance of a final certificate, the Contractor shall submit evidence satisfactory to the Owner that all payrolls, materials bills, and other indebtedness connected with the work have been paid. If the work has been substantially completed and the Owner certifies that full completion thereof is materially delayed through no

fault of the Contractor, the Owner shall, without terminating the Contract, make payment of the balance due for the portion of the work fully completed and accepted. Payment shall be made under the terms and conditions governing final payment, except that it shall not constitute a waiver of claims.

ARTICLE 6. NO DAMAGES FOR DELAY - OTHER CONTRACTORS

It shall be the affirmative duty of each and every Contractor on the project to cooperate and coordinate the scheduling and progress of its work with that of all other Contractors. Under no circumstances shall the State of Montana be liable for any damages for delay caused by the acts or omissions of another Contractor, and each Contractor expressly consents to suit by other Contractors for each and every claim for delay by said Contractors performing work on the aforementioned project. It is further stipulated and agreed that the terms of this provision shall govern over any other Contract document as defined in Article 7, infra.

ARTICLE 7. THE CONTRACT DOCUMENTS

The Bid Documents, together with this Agreement, form the Contract; and they are as totally a part of the Contract as if hereto attached or herein repeated. The following is an enumeration of the Contract Documents:

> Invitation for Bid, Instructions to Bidders, Landowner/Contact List, Proposal, Bid Bond, Certification of Nonsegregated Facilities, Notice of Award, Agreement, Performance Bond, Labor and Material Bond, Insurance Certificates, Consent of Surety, Notice to Proceed, Work Directive Change, Change Order, Affidavit on Behalf of Contractor, Approval of Subcontractors, Substitution Request Form, Schedule of Values, Payment Request, Schedule of Materials, Contractor's Certificate of Completion, Certificate of Substantial Completion, Certificate of Acceptance, Standard Specifications for Abandoned Mine Reclamation Construction (General Conditions, Supplementary Conditions, Technical Specifications), Special Provisions, Drawings, and Wage Rates.

ARTICLE 8. STANDARD PREVAILING RATE OF WAGES AND PREFERENCE OF MONTANA LABOR

The Contractor and Subcontractors shall pay the current Montana Prevailing Wage Rates, including fringe benefits for health and welfare and pension contributions and travel allowance provisions in effect and applicable to the county or locality in which the work is being performed. These prevailing wage rates will be in accordance with the most current determination including applicable modifications and will be attached to the Specifications and are incorporated herein.

ARTICLE 9. VENUE

In the event of litigation concerning the Contract, venue shall be the First Judicial District in and for the County of Lewis and Clark, Montana, and the agreement shall be interpreted according to the laws of Montana.

WHEREOF the parties hereto have executed this Agreement, the day and year first above written.

STATE OF MONTANA DEPARTMENT OF STATE LANDS	Ed Boland Construction Inc
Owner	Contractor
Commissioner	(Signature)
	Ed Boland President
	(Typed/Printed Name and Title)
8-26-91	July 5th. 1991
Date	Date

NOTICE TO PROCEED

TO: Del Sharbono
Sharbono Construction, Inc.
1826 North Main
Helena, MT 59601

DATE: July 30, 1991
PROJECT: Cascade Mine Drainage
Schedule I
MONT A/E or DSL-AMRB: 91-001

In accordance with the Agreement dated July 29, 1991, you are hereby notified to commence Work no later than AUGUST 1, 1991, and you are to complete the Work within 90 consecutive calendar days thereafter. The date of completion of all Work is, therefore, OCTOBER 29, 1991.

OWNER: DEPARTMENT OF STATE LANDS

By: Larry Marshall
Title: Bureau Chief

ACCEPTANCE OF NOTICE TO PROCEED

Receipt of the above Notice to Proceed is hereby acknowledged this 31 day of July, 1991.

CONTRACTOR: Sharbono Const.

By: Larry Sharbono
Title: Superintendent

Rev. 3/91

NOTICE TO PROCEED

TO: Ed Boland\Boland Construction
2608 9th Avenue North
Great Falls, MT 59401

DATE: April 20, 1992
PROJECT: Schedule 2, Cascade Mine Drainage
DSL-AMRB: 91-001, Schedule 2

In accordance with the Agreement dated August 26, 1991, you are hereby notified to commence Work no later than April 27, 1992, and you are to complete the Work within 90 consecutive calendar days thereafter. The date of completion of all Work is, therefore, July 25, 1992.

OWNER:DEPARTMENT OF STATE LANDS

By: John Koerth
Title: Program Supervisor
for: Bonnie Lovelace - Acting Bureau Chief

ACCEPTANCE OF NOTICE TO PROCEED

Receipt of the above Notice to Proceed is hereby acknowledged this 30TH day of APRIL, 1992

CONTRACTOR: ED BOLAND CONST. INC.

By: [signature]
Title: V. P.

Rev. 3/91

CASCADE MINE DRAINAGE 91-001
July 19, 1991
Pre-Construction Conference - Meeting Notes

A Pre-Construction Conference for the Cascade Mine Drainage Project, Schedule 1 was held at Centennial Park at Centerville, Montana at 11:30 a.m. on July 19, 1991. In attendance were the following representatives from Robert Peccia and Associates (RPA), Department of State Lands - Abandoned Mine Reclamation Bureau (DSL-AMRB) and Sharbono Construction:

John Koerth, DSL (Owner - Project Manager)
Stu Levit, DSL (Owner - Temporary Project Manager)
Robert Morton, RPA (Engineer - Project Manager)
Mike Ogden, RPA (Engineer - Project Inspector)
Loren Sharbono, Sharbono (Supervisor)
George Mitchell, Sharbono (Equipment Operator)

Robert Morton conducted the meeting. After introductions were made the meeting progressed following the Pre-construction Conference Agenda.

Schedule: The start date will be July 24, 1991, if all paperwork is in order and the contract is for 90 calendar days. The contractor plans on working 4 10 hour days per week. This was acceptable to the Engineer and DSL. It was requested by RPA and agreed by the Contractor to revise the construction sequence to install interceptor drains prior to wetlands and limestone trenches.

Insurance: Insurance requirements were discussed. All submittal would be received by DSL with enough time to review for compliance prior to issue of the Notice to Proceed. The Contract Protocol Table was referenced.

Submittals: Pre-construction submittal were discussed. The Contractor did not have them with him but would provide them prior to construction. The contractor was reminded that numerous submittal are required by the General Conditions, Supplementary Conditions (Traffic Plan, Explosives, Utilities), Special Provisions and Technical Specifications. Suggestions were made to the contractor to send pertinent portions of the Contract Documents to his suppliers. Lime was singled out as an important specification and problems with lime on past AMR projects were discussed. It was reiterated that subcontractors and suppliers are the responsibility of the Contractor.

Substitutions: Requirements for Contractor requested substitutions were discussed. These include shop drawings and Substitution Request Forms.

Pay Requests: John Koerth explained that the first pay request could be submitted by the Contractor prior to 30 days from the Notice to Proceed. The remaining requests would then be no less than 30 days after the preceding pay request. Material on hand could be paid for at 90% of invoice price if requested. The construction Supervisor and Inspector will meet to discuss work quantities for the pay requests. These meetings will likely coincide with the monthly progress meetings.

Change Orders: The process of completing Change Orders, Work Directive Changes and Field Decisions were discussed.

Interim Inspections: It was explained that interim inspections could be conducted at any time by either DSL or RPA.

Safety: The Contractor is responsible for all job safety including compliance with any regulatory agencies requirements.

Certified Payrolls: Certified payrolls may be submitted each time the Contractor pays his employees, but they must be submitted with each pay request at a minimum.

Progress Meeting: Progress meetings to track progress compared to the construction schedule will be held at least once monthly but may be held at any time at the request of any of the involved parties.

Inspections & Testing: It was explained that the Contractor was responsible for all testing except that specifically stated in the Technical Specifications as being the Engineers responsibility (density, slumps). The Technical Specifications listed in the Bid Package were noted for their testing, submittal, and specifications pertinent to the project. The engineer will be inspecting and testing materials to verify Contractor submitted items (lime, mulch, etc.). Surveying is the Contractors responsibility with the Engineer Inspector verifying.

Use of Premises: The Centerville Centennial Park will not be used to store materials or equipment. Unapproved disturbances caused by the Contractor shall be reclaimed by the Contractor at his cost. The inspector will contact area landowners prior to construction and the Contractor is welcome to be present during introductions.

The group then walked both sites (Centerville C and Stockett SE) with miscellaneous discussions about construction methods, etc. The Contractor was also shown approximate locations of various items such as interceptor drains, existing piping, limestone trenches, wetland cells and channels, etc. The adit at the Stockett site was found to be very small. It was determined to have the landowner show the exact location to the Contractor and the Inspector. It was discussed that if the opening that was found is indeed the adit noted by the landowner, then the opening would not require closure and the deletion would be handled through change order. Spotted Knapweed was found at the Stockett SE site and Leafy Spurge was found at both sites. The Contractor was instructed to comply with the Weed Control section of the Supplementary Conditions to prohibit the spread of these weeds during construction.

A copy of these Meeting Notes (June 24, 1991) is being sent to DSL and Sharbono. If any additions or corrections are required please direct comments to Bob Morton at RPA and a revision to these Meeting Notes will be conducted.

Bob Martin
Mike Eggen

DEPARTMENT OF STATE LANDS

STAN STEPHENS, GOVERNOR

CAPITOL STATION

STATE OF MONTANA

(406) 444-2074

1625 ELEVENTH AVENUE
HELENA, MONTANA 59620

June 5, 1991

MEMORANDUM

TO: Cascade Mine Drainage Reclamation Project Planholders

FROM: Stu Levit

RE: Addendum #1 and Information Requested at Pre-Bid

Attached find Addendum Number 1 for the Cascade Mine Drainage Reclamation Project (DSL-AMRB-91-001). If you have any questions please contact me.

Attached also find the planholders list, which was requested at the June 3, 1991 Pre-Bid Conference.

At the pre-bid we discussed the Standard Specifications for Abandoned Mine Reclamation Construction. These specifications are required for construction for the project. The specifications are incorporated by reference into the bid package. If you have any questions or need information regarding the Standard Specifications contact our office.

During last years construction projects we had some trouble with lime materials not meeting the contract specifications or the supplier's submittal certification. We will be intensely testing materials for specification compliance. You are encouraged to certify your materials before and during construction to insure compliance and reduce the chance of requiring additional materials or their being rejected.

Because only the CONTRACT DOCUMENTS (yellow) section need be submitted as your bid please give special attention be to boldly marking the bid envelope "SEALED BID" along with the contract name and number. This request will help our secretaries identify bids from regular mail. If you hand deliver make sure the bid is stamped by DSL personnel with the date and time.

SL/dlc

DEPARTMENT OF STATE LANDS

STAN STEPHENS, GOVERNOR

CAPITOL STATION

STATE OF MONTANA

(406) 444-2074

1625 ELEVENTH AVENUE
HELENA, MONTANA 59620

June 5, 1991

State of Montana
Invitation For Bid
DSL-AMRB-91-001
To Be Opened: 6/13/91
for
CASCADE MINE DRAINAGE RECLAMATION PROJECT
CASCADE COUNTY, MONTANA

ADDENDUM NO. 1

TO ALL PLANHOLDERS:

The following corrections and/or alterations to the plans and specifications for this project are as much a part and parcel of said plans and specifications as if included therein.

1. Add to Work Narrative, Plan Sheet 2 (sheet 2 of 12 in the Invitation for Bid):
   At the Centerville "C" site the coal spoil pile below the adit (Adit 2) shall NOT require Lime, Coversoil, Fertilizer, Seed, or Mulch work items. Because this area is small the Estimated Quantity (for bidding purposes) for these items will not change. Other work at this location remains unchanged.

2. Clarification of Plan Sheet 3 (sheet 3 of 12 in the Invitation for Bid):
   The STOCKETT SE SITE plan sheet identifies "ADDITIVE ALTERNATE I WORK" as the upper left portion of the sheet. This Additive Alternate is part of Schedule 1 and Schedule 2.

3. Add to 2nd paragraph, page P-1, Proposal:
   In the event Schedule 1 - Additive Alternate Number 1 is chosen the contract time shall be extended from 90 calendar days to 120 calendar days.

4. Add to Special Provisions 3.5(d):
   Submittals required in accordance with the Supplementary Conditions are written confirmation from the supplier describing the hay mix and certifying that the grass hay shall be free of noxious weeds. Noxious weed contaminated bales or entire stacks of bales shall be rejected by the Engineer.

All other terms and conditions of award remain as previously issued.

Sincerely,

Larry Marshall

Larry Marshall, Chief
Abandoned Mine Reclamation Bureau
Reclamation Division

LM/dlc

EE. 300,000

PLANHOLDER'S LIST

SHT. ___ OF ___

PROJECT NAME AND NUMBER Cascade Mine Drainage 91-00

BID DATE AND TIME June 13, 1991 2:00 p.m.

SET NO. PLANS	SET NO. SPECS.	PLANHOLDER NAME, ADDRESS & TELEPHONE NO.	DATE SENT	PAYMENT RCV'D CHECK NO.
1	1	FIRM NAME: Montana Contractors' Assoc. CONTACT PERSON: 1717 11th Ave. MAILING ADDRESS: Helena MT. 59601 PHONE NO. 442-4162	5-21-91	N/A
2	2	FIRM NAME: Great Falls Builders Exchange CONTACT PERSON: P.O. BOX 2027 MAILING ADDRESS: Great Falls MT 59403 PHONE NO. 453-2513		
3	3	FIRM NAME: Plan Library/Builders Exchange CONTACT PERSON: 2504 W. Main Suite L MAILING ADDRESS: Bozeman MT. 59715 PHONE NO. 586-7653		
4	4	FIRM NAME: Billings Builders Exchange CONTACT PERSON: 1643 Lewis Ave. Suite 205 MAILING ADDRESS: Billings MT. 59102 PHONE NO.		
5	5	FIRM NAME: Missoula Plans Exchange CONTACT PERSON: P.O. BOX 3109 MAILING ADDRESS: Missoula MT 59801 PHONE NO.		
6	6	FIRM NAME: Northwest Montana Plan Center CONTACT PERSON: 152 4th Ave. WN MAILING ADDRESS: Kalispell MT 59901 PHONE NO.		
7	7	FIRM NAME: Dodge Reports CONTACT PERSON: P.O. BOX 9207 MAILING ADDRESS: Boise Idaho 83707 PHONE NO.		
8	8	FIRM NAME: Butte Builders Exchange CONTACT PERSON: 1230 Harrison Ave. MAILING ADDRESS: Butte MT. 59701 PHONE NO.		
9	9	FIRM NAME: Ed Boland Construction Inc CONTACT PERSON: 7601 7th Ave. South MAILING ADDRESS: Great Falls MT 59405 PHONE NO.	5-20-91	$50.00 CK #6432
10	10	FIRM NAME: Sharbono Construction Inc. CONTACT PERSON: 1826 North Main MAILING ADDRESS: Helena MT. 59601 PHONE NO. 442-8122	5-21-91	$50 ck # 4734

Stanford Specs #34

Standard Specs #35

Department of State Lands
Abandoned Mine Reclamation Bureau
Capitol Station, Helena, Montana 59620
406/449-4560

PLANHOLDER'S LIST SHT. 2 OF ___

PROJECT NAME AND NUMBER Cascade Mine Drainage

BID DATE AND TIME June 13, 1991 2 pm

SET NO. PLANS	SET NO. SPECS.	PLANHOLDER NAME, ADDRESS & TELEPHONE NO.	DATE SENT	PAYMENT REC'D CHECK NO.
11	11	FIRM NAME: Dallett Minerals CONTACT PERSON: Irving Sewell MAILING ADDRESS: Box 169 Livingston 59047 PHONE NO. 222-1446	5/22/91	$20.00 Cash
12	12	FIRM NAME: D.H. Blattner & Sons, Inc. CONTACT PERSON: Jeff Stabnow MAILING ADDRESS: Box 2007 Missoula MT 59806 PHONE NO.	5/22/91	$20.00 Cash
13	13	FIRM NAME: Montgomery Construction CONTACT PERSON: John Montgomery MAILING ADDRESS: Hilger Montana Box 615 59451 PHONE NO.	5/23/91	$20.00 Ch. # 2101
14	14	FIRM NAME: CONTACT PERSON: Russell Martin MAILING ADDRESS: 322 Kerr Dam Rd. PHONE NO. Polson, Mt 59860-9711 883-2328	5/28/91	$20.00 ch # 3987
15	15	FIRM NAME: Shumaker Trucking + Excavating CONTACT PERSON: Joe Aline MAILING ADDRESS: Po Box 1442 MT 59403 PHONE NO. 727-3537	5/29/91	$20 ch # 9178
16	16	FIRM NAME: DeBoff Drilling Co., Inc. CONTACT PERSON: Gilt Edge Route MAILING ADDRESS: Lewistown MT. 59457 PHONE NO. 538-7355	5/29/91	$50 Ch # 47699
17	17	FIRM NAME: Maddox Construction CONTACT PERSON: Linda Maddox MAILING ADDRESS: PO Box 260 Hobson, Mt 59452 PHONE NO. 423-5416	5/31/91	$20 ch # 3153
18	18	FIRM NAME: Environcon, Inc. CONTACT PERSON: A.W. Appin MAILING ADDRESS: 101 International Way Msla, 59807 PHONE NO. 523-1150	5/31/41	$20 Ch # 1264 applic
19	19	FIRM NAME: Sedan, Inc. CONTACT PERSON: Billie Sedan MAILING ADDRESS: 283 Aero Lane PHONE NO 837-6839 Bigfork, MT 59911	6/3/91	$50 Ch. # 2737
20	20	FIRM NAME: DH Blattner + Sons CONTACT PERSON: Jeff Stabnow MAILING ADDRESS: Box 2007, Msla 59806 + Avon, MN 56310 PHONE NO. 543-3963 and (612) 356-7351	6/3/91	Invoiced

Standard Specs

Stand. Specs # 36

Stand. Specs # 38

Standard Specs # 1

Department of State Lands
Abandoned Mine Reclamation Bureau
Capitol Station, Helena, Montana 59620
406/449-4560

PLANHOLDER'S LIST SHT. ___ OF ___

PROJECT NAME AND NUMBER Cascade Mine Drainage

BID DATE AND TIME _____

SET NO. PLANS	SET NO. SPECS.	PLANHOLDER NAME, ADDRESS & TELEPHONE NO.	DATE SENT	PAYMENT REC'D CHECK NO.
21	21	FIRM NAME: United Materials of G.F., Inc CONTACT PERSON: 2100 9th A. North (Lonnie Anderson) MAILING ADDRESS: G.F. 59401 PHONE NO.	6/4/91	$50 ch # 1559
22	22	FIRM NAME: Kennie Construction : Kirby Key CONTACT PERSON: 347 Moccasin Trail MAILING ADDRESS: Billings 59105 PHONE NO. 665-1100	6/5/91	Invoiced
23	23	FIRM NAME: Dick Anderson Construction CONTACT PERSON: Dick Anderson MAILING ADDRESS: 3424 Highway 12 East PHONE NO. 443-3225 Helena MT. 59601	6/5/91	$50 Ch# 10745
24	24	FIRM NAME: Delhur Industries, Inc. CONTACT PERSON: 9833 Tumwater Access Rd. MAILING ADDRESS: P.O. Box 1116 PHONE NO. 457-1133 Port Angeles, WA 98362-0001	6/5/91	$50 Ch# 18089
25	25	FIRM NAME: Bonnes Construction CONTACT PERSON: Frank Bonnes MAILING ADDRESS: 4002 McGirl Rd PHONE NO. Billing 59105		
26	26	FIRM NAME: Hallett Minerals CONTACT PERSON: (Second Copy) MAILING ADDRESS: PHONE NO.		
27	27	FIRM NAME: CONTACT PERSON: MAILING ADDRESS: PHONE NO.		
28	28	FIRM NAME: CONTACT PERSON: MAILING ADDRESS: PHONE NO.		
29	29	FIRM NAME: CONTACT PERSON: MAILING ADDRESS: PHONE NO.		
30	30	FIRM NAME: CONTACT PERSON: MAILING ADDRESS: PHONE NO.		

Stand Specs #39

Stand Specs #40

Stand Specs #41

Stand Specs #43

Department of State Lands
Abandoned Mine Reclamation Bureau
Capitol Station, Helena, Montana 59620
406/449-4560

CASCADE MINE DRAINAGE
CENTERVILLE "C" AND STOCKETT SE
CASCADE COUNTY, MONTANA

DSL/AMRB 91-001
DATE JUNE 13, 1991

BID TABULATIONS				ENGINEER'S ESTIMATE		SHARBONO CONSTRUCTION HELENA, MT		SHUMAKER TRUCKING & EXCAVATING CONTRACTORS INC.		HALLETT RECLAMATION CO. LIVINGSTON, MT	
Item Number	Estimated Quantity	Unit	Description	Unit Price	Total Price						
SCHEDULE 1 - BASE BID					0.00		0.00		0.00		0.00
1.	1	LS	Mobilization, Bonding and Insurance	10,000.00	10,000.00	10,000.00	10,000.00	10,000.00	10,000.00	10,000.00	10,000.00
2.	1	LS	Site Access	5,000.00	5,000.00	12,880.00	12,880.00	10,000.00	10,000.00	2,956.00	2,956.00
3.	1	LS	Site Dewatering	10,000.00	10,000.00	9,844.00	9,844.00	4,000.00	3,000.00	619.00	619.00
4.	1	LS	Site Earthwork	19,000.00	19,000.00	31,400.00	31,400.00	66,920.00	66,920.00	25,068.00	25,068.00
5.	1	LS	Fine Grading	2,500.00	2,500.00	2,240.00	2,240.00	10,000.00	17,000.00	1,970.00	1,970.00
6.	71400	SF	Bentonite Seal	0.50	35,700.00	0.39	27,846.00	0.50	35,700.00	0.27	19,278.00
7.	57,100	SF	Membrane Liner - PVC	0.50	28,550.00	0.49	27,979.00	0.43	24,553.00	0.44	25,124.00
8.	19580	SF	Membrane Liner - Hypalon	1.25	24,475.00	1.40	27,412.00	1.25	24,475.00	1.32	25,845.60
9.	1475	CY	Filter Gravel	25.00	36,875.00	20.00	1,500.00	20.00	29,500.00	26.80	39,530.00
10.	1407	CY	Peat	25.00	35,175.00	35.00	49,245.00	35.00	49,245.00	69.36	97,589.52
11.	1065	CY	Peat - DCW	40.00	42,600.00	35.00	37,275.00	43.00	45,795.00	118.79	126,511.35
12.	300	EA	Hay Bale Dikes	4.00	1,200.00	5.00	1,500.00	10.00	3,000.00	8.02	2,406.00
13.	5.0	Acre	Lime Application	1,000.00	5,000.00	1,800.00	9,000.00	2,000.00	10,000.00	2,975.99	14,879.95
14.	1	EA	Stock Tank, 1000 gallon	1,000.00	1,000.00	2,500.00	2,500.00	2,000.00	2,000.00	1361.02	1,361.02
15.	3	EA	Weir Outlet Structure	1,000.00	3,000.00	800.00	2,400.00	1,500.00	4,500.00	1,187.40	3,562.20
16.	11000	SF	Geocomposite	2.00	22,000.00	1.25	13,750.00	1.25	13,750.00	1.09	11,990.00
17.	3650	LF	Drain Pipe - 4"	4.00	14,600.00	8.00	29,200.00	7.00	25,550.00	2.03	7,409.50
18.	2860	LF	Perforated Pipe - 4"	2.00	5,720.00	9.00	25,740.00	7.00	20,020.00	1.46	4,175.60

BID TABULATIONS				ENGINEER'S ESTIMATE		SHARBONO CONSTRUCTION HELENA, MT		SHUMAKER TRUCKING & EXCAVATING CONTRACTORS INC.		HALLETT RECLAMATION CO. LIVINGSTON, MT	
Item Number	Estimated Quantity	Unit	Description	Unit Price	Total Price						
19.	20	LF	18" PE Culvert	25.00	500.00	40.00	800.00	25.00	500.00	18.49	369.80
20.	34	EA	Drain Pipe Concrete Anchors	150.00	5,100.00	100.00	3,400.00	50.00	1,700.00	42.44	1,442.96
21.	64	EA	Pipe Cleanout Assembly	400.00	25,600.00	75.00	4,800.00	150.00	9,600.00	22.44	1,436.16
22.	28	EA	Appurtenances, 4" Type 1	50.00	1,400.00	88.00	2,464.00	50.00	1,400.00	9.88	276.64
23.	102	EA	Appurtenances, 4" Type 2	25.00	2,550.00	86.00	8,772.00	25.00	2,550.00	5.73	584.46
24.	10	EA	PVC Valves, 4"	370.00	3,700.00	280.00	2,800.00	500.00	5,200.00	267.21	2,672.10
25.	4	EA	Service Hole, 72"	3,000.00	12,000.00	2,790.00	11,160.00	3,500.00	14,766.00	3,162.24	12,648.96
26.	270	CY	Limestone Aggregate	50.00	13,500.00	15.00	4,050.00	33.00	8,910.00	28.87	7,794.90
27.	6820	SY	Cushion Fabric	1.00	6,820.00	2.85	19,437.00	1.00	6,820.00	1.14	7,774.80
28.	52	CY	Riprap	25.00	1,300.00	40.00	2,080.00	30.00	1,560.00	32.28	1,678.56
29.	2	EA	Close Mine Opening - Adit	500.00	1,000.00	950.00	1,900.00	1,000.00	2,000.00	194.51	389.02
30.	2800	CY	Import Cover Soil	10.00	28,000.00	6.50	18,200.00	6.60	18,308.00	16.35	45,780.00
31.	8.0	Acre	Fertilize and Seed	700.00	5,600.00	950.00	7,600.00	500.00	4,560.00	315.20	2,521.60
32.	8.0	Acre	Mulch	700.00	5,600.00	650.00	5,200.00	1,000.00	8,000.00	281.66	2,253.28
33.	5100	LF	Remove and Salvage Fence	1.00	5,100.00	0.35	1,785.00	0.60	3,060.00	0.11	561.00
34.	6420	LF	Farm Fence (Type F-4M)	1.00	9,630.00	2.40	14,766.00	1.75	11,235.00	1.72	11,042.40
35.	15	EA	Farm Fence Gate, 16'	75.00	1,125.00	70.00	4,050.00	96.00	1,440.00	261.20	3,918.00
36.	4295	LF	Farm Fence (type F-5M)	1.75	7,516.25	2.40	10,308.00	0.60	8,050.00	1.85	7,945.75
37.	200	SY	Erosion Control Mat, Vinyl	7.50	1,500.00	7.50	1,500.00	6.00	1,200.00	7.41	1,482.00
38.	2300	SY	Erosion Control Mat, Biodegradable	7.50	17,250.00	5.25	12,075.00	5.00	11,500.00	4.77	10,971.00
TOTAL - SCHEDULE 1					457,186.25		483,458.00		515,873.00		543,819.13

BID TABULATIONS				ENGINEER'S ESTIMATE		SHARBONO CONSTRUCTION HELENA, MT		SHUMAKER TRUCKING & EXCAVATING CONTRACTORS INC.		HALLETT RECLAMATION CO. LIVINGSTON, MT	
Item Number	Estimated Quantity	Unit	Description	Unit Price	Total Price						
SCHEDULE 1 - ADDITIVE ALTERNATE NO. 1 - CASCADE MINE DRAINAGE							0.00		0.00		0.00
1.	1	LS	Site Access	500.00	500.00	3,000.00	3,000.00	5,000.00	5,000.00	601.00	601.00
2.	1	LS	Site Dewatering	2,000.00	2,000.00	5,000.00	5,000.00	2,000.00	2,000.00	486.00	486.00
3.	1	LS	Site Earthwork	8,000.00	8,000.00	12,000.00	12,000.00	16,000.00	16,000.00	12,942.00	12,942.00
4.	1	LS	Fine Grading	1,000.00	1,000.00	2,000.00	2,000.00	3,000.00	3,000.00	866.00	866.00
5.	16000	SF	Bentonite Seal	0.50	8,000.00	0.40	6,400.00	0.50	8,000.00	0.29	4,640.00
6.	12600	SF	Membrane Liner - PVC	0.50	6,300.00	0.68	8,568.00	0.43	5,418.00	0.70	8,820.00
7.	4100	SF	Membrane Liner - Hypalon	1.25	5,125.00	1.70	6,970.00	1.25	5,125.00	1.38	5,658.00
8.	750	CY	Filter Gravel	25.00	18,750.00	22.00	16,500.00	20.00	15,000.00	28.05	21,037.50
4.	1000	CY	Peat	25.00	25,000.00	35.00	35,000.00	35.00	35,000.00	72.58	72,580.00
10.	100	EA	Hay Bale Dikes	4.00	300.00	0.68	500.00	10.00	1,000.00	8.39	839.00
11.	0.2	Acre	Lime Applications	1,000.00	200.00	1,900.00	380.00	2,000.00	400.00	3,114.03	622.81
12.	2	EA	Weir Outlet Structure	1,000.00	2,000.00	800.00	1,600.00	1,500.00	3,000.00	1,242.48	2,484.96
10.	30	LF	Drain Pipe, 4"	4.00	120.00	26.00	750.00	7.00	210.00	2.12	63.60
10.	2	EA	Drain Pipe Concrete Anchors	150.00	300.00	100.00	200.00	50.00	100.00	44.41	88.82
15.	5	EA	Appurtenances, 4" Type 2	25.00	125.00	86.00	430.00	25.00	125.00	5.99	29.95
10.	1000	SY	Cushion Fabric	1.00	1,500.00	2.85	4,275.00	1.00	1,500.00	1.19	1,785.00
10.	50	SY	Bank Stabilization Fabric	2.50	125.00	3.50	175.00	3.00	150.00	11.49	574.50
10.	870	CY	Riprap	25.00	21,750.00	25.00	21,750.00	25.00	21,750.00	33.78	29,388.60
10.	200	CY	Import Coversoil	10.00	2,000.00	5.00	1,000.00	6.00	1,200.00	17.11	3,422.00
20.	0.5	Acre	Fertilize and Seed	700.00	350.00	12.00	6.00	500.00	250.00	329.82	164.91
21.	0.5	Acre	Mulch	700.00	350.00	1,000.00	500.00	1,500.00	750.00	294.73	147.37

BID TABULATIONS				ENGINEER'S ESTIMATE		SHARBONO CONSTRUCTION HELENA, MT		SHUMAKER TRUCKING & EXCAVATING CONTRACTORS INC.		HALLETT RECLAMATION CO. LIVINGSTON, MT	
Item Number	Estimated Quantity	Unit	Description	Unit Price	Total Price						
22.	2	EA	Farm Fence Gate, 16'	75.00	150.00	70.00	140.00	96.00	192.00	273.32	546.64
23.	1100	LF	Farm Fence (Type F-5M)	1.75	1,925.00	2.40	2,640.00	2.00	2,200.00	1.94	2,134.00
24.	350	SY	Erosion Control Mat, Vinyl	7.50	2,625.00	7.50	2,625.00	6.00	2,100.00	7.75	2,712.50
Total - Schedule 1 - Additive Alternate No. 1					108,595.00		132,409.00		129,470.00		172,635.16
Schedule 2 - Base Bid							0.00		0.00		0.00
1.	1	LS	Mobilization, Bonding and Insurance	1,000.00	1,000.00		0.00	1,000.00	1,000.00		0.00
2.	36500	SF	Transplant Wetland Vegetation	0.50	18,250.00		0.00	1.73	63,145.00		0.00
3.	25	EA	Transplant Trees	200.00	5,000.00		0.00	259.00	6,475.00		0.00
Total - Schedule 2 - Base Bid					24,250.00	NO BID	0.00		70,620.00	NO BID	0.00
Schedule 2 - Additive Alternate No. 1							0.00		0.00		0.00
1.	13500	SF	Transplant Wetland Vegetation	0.50	6,750.00	NO BID	0.00	1.73	23,355.00		0.00
Total - Schedule 2 Additive Alternate 1					6,750.00		0.00		23,355.00	NO BID	0.00
SUMMARY OF BID											
Total: Schedule 1 - Base Bid					457,186.25		483,458.00		515,873.00		543,819.13
Total: Schedule 1 - Additive Alternate No. 1					108,595.00		132,409.00		129,470.00		172,635.16
Total: Schedule 2 - Base Bid					24,250.00		0.00		70,620.00		0.00
Total: Schedule 2 - Additive Alternate No. 1					6,750.00		0.00		23,355.00		0.00
GRAND TOTAL - CENTERVILLE "C" AND STOCKETT SE					596,781.25		615,867.00		739,318.00		716,454.29

CASCADE MINE DRAINAGE
CENTERVILLE "C" AND STOCKETT SE
CASCADE COUNTY, MONTANA

DSL/AMRB 91-001
DATE JUNE 13, 1991

BID TABULATIONS				ENGINEER'S ESTIMATE		D.H. BLATTNER & SONS, INC. AVON, MN		ED BOLAND CONST. INC. GREAT FALLS, MT		X	
Item Number	Estimated Quantity	Unit	Description	Unit Price	Total Price						
SCHEDULE 1 - BASE BID					0.00		0.00		0.00		0.00
1.	1	LS	Mobilization, Bonding and Insurance	10,000.00	10,000.00	10,000.00	10,000.00	10,000.00	10,000.00		0.00
2.	1	LS	Site Access	5,000.00	5,000.00	4,180.00	4,180.00	8,500.00	8,500.00		0.00
3.	1	LS	Site Dewatering	10,000.00	10,000.00	3,425.00	3,425.00	2,000.00	2,000.00		0.00
4.	1	LS	Site Earthwork	19,000.00	19,000.00	93,500.00	93,500.00	79,700.00	79,700.00	52598	0.00
5.	1	LS	Fine Grading	2,500.00	2,500.00	13,775.00	13,775.00	2,000.00	2,000.00		0.00
6.	71400	SF	Bentonite Seal	0.50	35,700.00	0.35	24,990.00	0.66	47,124.00		0.00
7.	57,100	SF	Membrane Liner - PVC	0.50	28,550.00	0.55	31,405.00	0.42	23,982.00		0.00
8.	19580	SF	Membrane Liner - Hypalon	1.25	24,475.00	1.50	29,370.00	1.30	25,454.00		0.00
9.	1475	CY	Filter Gravel	25.00	36,875.00	27.10	39,972.50	24.00	35,400.00		0.00
10.	1407	CY	Peat	25.00	35,175.00	33.80	47,556.60	39.65	55,787.55		0.00
11.	1065	CY	Peat - DCW	40.00	42,600.00	45.10	48,031.50	52.00	55,380.00		0.00
12.	300	EA	Hay Bale Dikes	4.00	1,200.00	8.95	2,685.00	6.25	1,875.00		0.00
13.	5.0	Acre	Lime Application	1,000.00	5,000.00	680.25	3,401.25	2,672.00	13,360.00		0.00
13.	1	EA	Stock Tank, 1000 gallon	1,000.00	1,000.00	2,450.75	2,450.75	1,500.00	4,500.00		0.00
15.	3	EA	Weir Outlet Structure	1,000.00	3,000.00	2,035.00	6,105.00	1,500.00	4,500.00		0.00
16.	11000	SF	Geocomposite	2.00	22,000.00	0.80	8,800.00	1.31	14,410.00		0.00
17.	3650	LF	Drain Pipe - 4"	4.00	14,600.00	9.05	33,032.50	19.76	72,124.00		0.00
18.	2860	LF	Perforated Pipe - 4"	2.00	5,720.00	17.10	48,906.00	29.14	83,340.40		0.00

BID TABULATIONS				ENGINEER'S ESTIMATE		D.H. BLATTNER & SONS, INC. AVON, MN		ED BOLAND CONST. INC. GREAT FALLS, MT			
Item Number	Estimated Quantity	Unit	Description	Unit Price	Total Price						
22.	2	EA	Farm Fence Gate, 16'	75.00	150.00	57.50	115.00	125.00	250.00		0.00
23.	1100	LF	Farm Fence (Type F-5M)	1.75	1,925.00	1.50	1,650.00	2.50	2,750.00		0.00
24.	350	SY	Erosion Control Mat, Vinyl	.50	2,625.00	8.05	2,817.50	10.25	3,587.50		0.00
Total - Schedule 1 - Additive Alternate No. 1					108,595.00		225,993.18		145,326.30		0.00
Schedule 2 - Base Bid											
1.	1	LS	Mobilization, Bonding and Insurance	1,000.00	1,000.00		0.00	1,000.00	1,000.00		0.00
2.	36500	SF	Transplant Wetland Vegetation	0.50	18,250.00		0.00	1.50	54,750.00		0.00
3.	2.	EA	Transplant Trees	200.00	5,000.00		0.00	235.00	5,875.00		0.00
Total - Schedule 2 - Base Bid					24,250.00		0.00		61,625.00		0.00
Schedule 2 - Additive Alternate No. 1											
1.	13500	SF	Transplant Wetland Vegetation	0.50	6,750.00		0.00	1.50	20,250.00		0.00
Total - Schedule 2 Additive Alternate 1					6,750.00		0.00		20,250.00		0.00
SUMMARY OF BID											
Total: Schedule 1 - Base Bid					457,186.25		605,267.80		681,913.25		0.00
Total: Schedule 1 - Additive Alternate No. 1					108,595.00		225,993.18		145,326.30		0.00
Total: Schedule 2 - Base Bid					24,250.00		0.00		61,625.00		0.00
Total: Schedule 2 - Additive Alternate No. 1					6,750.00		0.00		20,250.00		0.00
GRAND TOTAL - CENTERVILLE "C" AND STOCKETT SE					596,781.25		831,260.98		909,114.55		0.00

BID TABULATIONS				ENGINEER'S ESTIMATE		D.H. BLATTNER & SONS, INC. AVON, MN		ED BOLAND CONST. INC. GREAT FALLS, MT			
Item Number	Estimated Quantity	Unit	Description	Unit Price	Total Price						
SCHEDULE 1 - ADDITIVE ALTERNATE NO. 1 - CASCADE MINE DRAINAGE							0.00		0.00		0.00
1.	1	LS	Site Access	500.00	500.00	1,400.00	1,400.00	500.00	500.00		0.00
2.	1	LS	Site Dewatering	2,000.00	2,000.00	2,390.00	2,390.00	20,000.00	20,000.00		0.00
3.	1	LS	Site Earthwork	8,000.00	8,000.00	26,670.00	26,670.00	11,500.00	11,500.00		0.00
4.	1	LS	Fine Grading	1,000.00	1,000.00	5,825.00	5,825.00	500.00	500.00		0.00
5.	16000	SF	Bentonite Seal	0.50	8,000.00	0.47	7,520.00	0.66	10,560.00		0.00
6.	12600	SF	Membrane Liner - PVC	0.50	6,300.00	0.99	12,474.00	0.60	7,560.00		0.00
7.	4100	SF	Membrane Liner - Hypalon	1.25	5,125.00	2.15	8,815.00	1.60	6,560.00		0.00
8.	750	CY	Filter Gravel	25.00	18,750.00	29.30	21,975.00	24.00	18,000.00		0.00
9.	1000	CY	Peat	25.00	25,000.00	34.00	38,500.00	39.65	39,650.00		0.00
10.	100	EA	Hay Bale Dikes	0.50	400.00	10.50	1,050.00	6.25	625.00		0.00
11.	0.2	Acre	Lime Applications	1,000.00	200.00	2,674.00	534.80	3,000.00	600.00		0.00
12.	2	EA	Weir Outlet Structure	1,000.00	2,000.00	1,747.00	3,494.00	1,500.00	3,000.00		0.00
13.	30	LF	Drain Pipe, 4"	0.50	120.00	28.50	855.00	29.76	892.80		0.00
14.	2	EA	Drain Pipe Concrete Anchors	150.00	300.00	105.00	210.00	62.00	124.00		0.00
15.	5	EA	Appurtenances, 4" Type 2	25.00	125.00	9.50	47.50	30.00	150.00		0.00
16.	1500	SY	Cushion Fabric	1.00	1,500.00	2.35	3,525.00	1.67	2,505.00		0.00
17.	50	SY	Bank Stabilization Fabric	2.50	125.00	19.75	987.50	5.00	250.00		0.00
18.	870	CY	Riprap	25.00	21,750.00	34.00	29,580.00	15.00	13,050.00		0.00
19.	200	CY	Import Coversoil	10.00	2,000.00	275.00	55,000.00	8.56	1,712.00		0.00
20.	0.5	Acre	Fertilize and Seed	700.00	350.00	455.75	227.88	1,000.00	500.00		0.00
21.	0.5	Acre	Mulch	700.00	350.00	660.00	330.00	1,000.00	500.00		0.00

BID TABULATIONS				ENGINEER'S ESTIMATE		D.H. BLATTNER & SONS, INC. AVON, MN		ED BOLAND CONST. INC. GREAT FALLS, MT			
Item Number	Estimated Quantity	Unit	Description	Unit Price	Total Price						
19.	20	LF	18" PE Culvert	25.00	500.00	19.40	388.00	30.00	600.00		0.00
20.	34	EA	Drain Pipe Concrete Anchors	150.00	5,100.00	145.20	4,936.80	62.00	2,108.00		0.00
21.	64	EA	Pipe Cleanout Assembly	400.00	25,600.00	116.75	7,472.00	125.00	8,000.00		0.00
22.	28	EA	Appurtenances, 4" Type 1	50.00	1,400.00	18.70	523.60	86.00	2,408.00		0.00
23.	102	EA	Appurtenances, 4" Type 2	25.00	2,550.00	10.50	1,071.00	30.00	3,060.00		0.00
24.	10	EA	PVC Valves, 4"	370.00	3,700.00	278.00	2,780.00	250.00	2,500.00		0.00
25.	4	EA	Service Hole, 72"	3,000.00	12,000.00	2,900.00	11,600.00	3,950.00	15,800.00		0.00
26.	270	CY	Limestone Aggregate	50.00	13,500.00	47.25	12,757.50	55.00	14,850.00		0.00
27.	6820	SY	Cushion Fabric	1.00	6,820.00	2.25	15,345.00	1.67	11,389.40		0.00
28.	52	CY	Riprap	25.00	1,300.00	68.15	3,543.80	22.00	1,144.00		0.00
29.	2	EA	Close Mine Opening - Adit	500.00	1,000.00	1,280.00	2,560.00	1,000.00	2,000.00		0.00
30.	2800	CY	Import Cover Soil	10.00	28,000.00	18.75	52,500.00	8.56	23,968.00		0.00
31.	8.0	Acre	Fertilize and Seed	700.00	5,600.00	490.00	3,920.00	930.00	7,440.00		0.00
32.	8.0	Acre	Mulch	700.00	5,600.00	610.00	4,880.00	930.00	7,440.00		0.00
33.	5100	LF	Remove and Salvage Fence	1.00	5,100.00	0.55	2,805.00	0.75	3,825.00		0.00
34.	6420	LF	Farm Fence (Type F-4M)	1.50	9,630.00	1.60	10,272.00	2.17	13,931.40		0.00
35.	15	EA	Farm Fence Gate, 16'	75.00	1,125.00	47.55	713.25	125.00	1,875.00		0.00
36.	4295	LF	Farm Fence (type F-5M)	1.75	7,516.25	1.25	5,368.75	2.50	10,737.50		0.00
37.	200	SY	Erosion Control Mat, Vinyl	7.50	1,500.00	8.10	1,620.00	10.25	2,050.00		0.00
38.	2300	SY	Erosion Control Mat, Biodegradable	7.50	17,250.00	3.75	8,625.00	4.50	10,350.00		0.00
TOTAL - SCHEDULE 1					457,186.25		605,267.80		681,913.25		0.00

Attachment B. Change Orders & Work Directives

RECEIVED
OCT - 3 1991
STATE LANDS

CHANGE ORDER

ORDER NO 1

PROJECT TITLE: Cascade Mine Drainage - Schedule 1, Base Bid

MONT A/E or DSL-AMRB: 91-001

CONTRACT DATE: July 29, 1991

OWNER: Dept. of State Lands - Abandoned Mine Reclamation Bureau

CONTRACTOR: Sharbono Construction, Inc.

Change Orders must be accompanied by an itemized cost breakdown. You are hereby requested to comply with the following changes from the Contract Documents. (Show separate costs for materials, labor, equipment, and miscellaneous. Show percent where applicable.)

ITEM NO.	DESCRIPTION OF CHANGES - ESTIMATED QUANTITIES & UNITS	COST OF CHANGES					TOTAL COST
		MAT'L	LABOR	EQUIP.	MISC.	TOTAL UNIT COST	
1.	Increase Welland Size - See attachment 1 & 2 and revised plan sheets 2R & 2RA					See Attach 1	111,071.90
2.	Add-Limestone Aggregate mix with peat - See attachment 1 & 2					See Attach 1	5,280.00
3.	Increase quantity-geocomposite See attachment 1					See Attach 1	22,800.00
	TOTAL COST - MATERIALS, LABOR, EQUIPMENT & MISC.						$139,151.90
	OVERHEAD & PROFIT @ ____%						0.00
	GRAND TOTAL - THIS CHANGE ORDER						139,151.90

Original Contract Price	$483,458.00
Current Contract Price Adjusted by Previous Change Order	$483,458.00
Cost this Change Order (+ or -)	$139,151.90
New Contract Price including this Change Order	$622,609.90

The completion date as set forth in the Contract Documents shall be (increased) by 30 calendar days.

The date for completion of all work will be November 28, 1991.

Description and Justification for Change:

1. Increasing wetland size at the Centerville "C" site is based on newly available sizing recommendations. These recommendations use acidity loading in lieu of iron loading to the wetland and result in larger wetland sizes for highly acidic mine drainage treatment. This increase results in quantity increases for the following bid item numbers: 4, 5, 6, 7, 9, 12, 15, 17, 18, 22, 23, and 27. A new item, Peat-OM provides a less expensive wetland organic substrate.

2. Recent research recommendations are to include 20%-25% (dry wt.) limestone aggregate into wetland organic substrate to optimize acid drainage treatment. The limestone is to be mixed into all peat in the wetlands. This is a new construction item.

3. Excavation and installation of project interceptor drains has revealed the need to install extra heights of geocomposite in the excavation trenches. This is necessary because water is seeping from more than one elevation in the trenches. Also, additional interceptor drains in other than planned locations need to be installed to adequately intercept the mine drainage seepage. The increases bid items number 16, 17, and 18.

SURETY CONSENT

The Surety hereby consents to the aforementioned Contract Change Order and agrees that its bond or bonds shall apply and extend to the Contract as thereby modified or amended per this Change Order. The Principal and the Surety further agree that on or after execution of this consent, the penalty of the applicable Performance Bonds or Bonds is hereby increased by $ 139,151.90 (100% of the Change Order amount) and the penalty of the applicable Labor and Material Bond or Bonds is hereby increased by $ 139,151.90 (100% of the Change Order amount).

COUNTERSIGNED BY MONTANA RESIDENT AGENT

SURETY Reliance Insurance Company

Gordon D McManus

By: Gillett C Dunbar

Seal

Recommended by: ROBERT PEccIA & ASSOC Robert B Morton 10/3/91

Engineer Date

Accepted by: SHAMROCK COAST, INC. 10/3/91

Contractor Date

Approved by: MC 10/1, 1991

Owner Date

CASCADE MINE DRAINAGE

DSL-AMRB 91-001
Change Order No.1 - Attachment 1

Item No.	Bid Item No. (If Applicable)	Description	Quantity	Unit	Unit Cost	Total Cost
1.		Increase Wetland Size at Centerville "C" Site by 0.7 AC				
1a.	4	Inc. Quant. - Site Earthwork, 2350 CY @ $7.50/CY	1	LS	17,625.00	17,625.00
1b.	5	Inc. Quant. - Fine Grading, 0.7 AC @ $1867/AC	1	LS	1,306.90	1,306.90
1c.	6	Inc. Quant. - Bentonite Seal	12,500	SF	0.39	4,875.00
1d.	7	Inc. Quant. - Membrane Liner	12,500	SF	0.49	6,125.00
1e.	9	Inc. Quant. - Filter Gravel	1,320	CY	20.00	26,400.00
1f.		Add - Peat-OM (New Item)	2,375	CY	20.00	47,500.00
1g.	13	Inc. Quant. - Hay Bale Dikes	300	EA	5.00	1,500.00
1h.	15	Inc. Quant. - Weir Outlet Structure	1	EA	800.00	750.00
1i.	17	Inc. Quant. - Drain Pipe, 4"	30	LF	8.00	240.00
1j.	18	Inc. Quant. - Perforated Pipe, 4"	50	LF	9.00	450.00
1k.	22	Inc. Quant. - Appurtenances, 4" Type 1	1	EA	88.00	88.00
1h.	23	Inc. Quant. - Appurtenances, 4" Type 2	2	EA	86.00	172.00
1m.	27	Inc. Quant. - Cushion Fabric	1400	SY	2.85	3,990.00
		TOTAL ITEM 1				111,071.90
2.		Add - Limestone Aggregate Mix with Peat @ 0.055 CY Limestone/1 CY Peat	264	CY	20.00	5,280.00
		TOTAL ITEM 2				5,280.00
3.		Increase Interceptor Drain System				
3a.	16	Inc. Quant. - Geocomposite	12,200	SF	1.25	15,250.00
3b.	17	Inc. Quant. - Drain Pipe,4"	400	LF	8.00	3,200.00
3c.	18	Inc. Quant. - Perforated Pipe,4"	400	LF	9.00	3,600.00
3b.	21	Inc. Quant. - Pipe Cleanouts	10	EA	75.00	750.00
		TOTAL ITEM 3				22,800.00
		TOTAL ALL ITEMS CHANGE ORDER NO. 1				$ 139,151.90

Signed

10/3/91
Date

CASCADE MINE DRAINAGE

DSL-AMRB 91-001
Change Order No.1 - Attachment 2

1. Add - Special Provision 3.20(k) Peat-OM (insert after paragraph 2).

Peat-OM is the additional material required to increase the size of the wetland at Centerville "C" and is in addition to the specified Peat & Peat-DCW. Peat-OM will consist of a mix of two products. The base product shall be straw, hay, peat moss or wood chips/mulch and the secondary product will be composted manure (cattle or poultry) or treated sewage sludge. The products shall be thoroughly mixed at a rate of 60% to 80% base product and 40% to 20% secondary product. All products shall be approved in writing by the Engineer prior to use.

Submittals shall include:

* Name, address and phone number of the product suppliers.
* Proposed product amounts and mixing methods.
* Product samples of 1 to 5 gallon size.

The placment location of the three peat types shall be as follows: Peat-DCW in wetland cell 3 and the wetland channel at Stockett SE; Peat in wetland cell 1; and Peat-OM in wetland cell 2. Excess material from bid quantities for Peat and Peat-DCW shall be used and shall be placed at the inlet end of wetland cell 2. Measurement and payment shall be the same as Peat & Peat-DCW.

2. Add - Special Provision 3.20(t) Limestone Aggregate Mix with Peat.

This item consists of mixing Limestone Aggregate as specified in Special Provision 3.15 with all peat (Peat, Peat-DCW and Peat-OM) installed on the project. The mixing rate shall be 0.055 cubic yards (150 pounds) of Limestone Aggregate with each cubic yard of peat (about 1CY Limestone/18CY Peat).

Submittals shall include:

* Proposed mixing methods.
* Same as specified for Limestone Aggregate, Special Provision 3.15 (duplicate not necessary if same material).

Measurement and payment shall be based on the volume of Limestone Aggregate delivered and mixed with the peat and installed, as determined by the field engineer.

WORK DIRECTIVE CHANGE

(Instructions on Reverse Side) No. 1

PROJECT: Cascade Mine Drainage

DATE OF ISSUANCE: August 7, 1991

CONTRACTOR: Sharbono Construction, Inc.
(Name, Address) 1826 N. Last Chance Gulch
Helena, MT 59601

OWNER: Department of State Lands
Abandoned Mine Reclamation Bureau

MONT A/E or DSL-AMRB: 91-001

CONTRACT FOR: Schedule I Base Bid

ENGINEER: Robert Peccia & Associates

You are directed to proceed promptly with the following change(s):

Description: At Centerville "C" Site, ~~replace~~ CLEANOOT existing 4" PVC pipe and ~~adit~~ REPLACE drainage structure.

Purpose of Work Directive Change: ~~Replace~~ CLEAN OOT clogged pipe and / REPLACE drainage structure. Solidify payment basis proir to change order.

Attachments: (list documents supporting change) See attachment

---

If a claim is made that the above change(s) have affected Contract Price or Contract Time, any claim for a Change Order based thereon will involve one of the following methods of determining the effect of the change(s).

Method of determining change in Contract Price:

- ☐ Time and Materials
- ☒ Unit Prices
- ☐ Cost Plus Fixed Fee
- ☒ Other equipment rent rate

Method of determining change in Contract Time:

- ☐ Contractor's Records
- ☒ Engineer's Records
- ☐ Other _____

Estimated increase (decrease) in Contract Price: $ ~~3545.00~~ 2445.00 ~~5,435.00~~. If the change involves an increase, the estimated amount is not to be exceeded without further authorization.

Estimated increase (decrease) in Contract Time: 3 days. If the change involves an increase, the estimated time is not to be exceeded without further authorization.

RECOMMENDED: Robert Peccia & Associates

By Robert B Morton RBM 8/23/91
Engineer

AUTHORIZED: Dept. of State Lands - AMRB

By John Tourtellotte
Owner

ACCEPTED: Sharbono Construction, Inc.

By Robert D'Ellington P.S. 8-23-91
Contractor

WORK DIRECTIVE CHANGE

INSTRUCTIONS

A. GENERAL INFORMATION

This document was developed for use in situations involving changes in the Work which, if not processed expeditiously, might delay the Project. These changes are often initiated in the field and may affect the Contract Price or the Contract Time. This is not a Change Order, but only a directive to proceed with Work that may be included in a subsequent Change Order.

For supplemental instructions and minor changes not involving a change in the Contract Price or the Contract Time, a Field Order may be issued.

B. COMPLETING THE WORK DIRECTIVE CHANGE

Engineer initiates the form, including a description of the items involved and attachments.

Based on conversations between Engineer and Contractor, Engineer completes the following:

METHOD OF DETERMINING CHANGE, IF ANY, IN CONTRACT PRICE: Mark the method to be used in determining the final cost of Work involved and the net effect on the Contract Price. If the change involves an increase in the Contract Price and the estimated amount is approached before the additional or changed work is completed, another Work Directive Change must be issued to change the amount or Contractor may stop the changed Work when the estimated amount is reached. If the Work Directive Change is not likely to change the Contract Price, the space for estimated increase (decreased) should be marked "Not Applicable".

METHOD OF DETERMINING CHANGE, IF ANY, IN CONTRACT TIME: Mark the method to be used in determining the change in Contract Time and the estimated increase or decrease in Contract Time. If the change involves an increase in the Contract Time and the estimated time is approached before additional or changed Work is completed, another Work Directive Change must be issued to change the time or Contractor may stop the changed Work when the estimated time is reached. If the Work Directive Change is not likely to change the Contract Time, the space for estimated increase (decrease) should be marked "Not Applicable".

Once Engineer has completed and signed the form, all copies should be sent to Owner for authorization because Engineer alone does not have authority to authorize changes in price or time. Once authorized by Owner, a copy should be sent by Engineer to Contractor.

Once the Work covered by this directive is completed for final cost and time determined, Contractor should submit documentation for inclusion in a Change Order.

THIS IS A DIRECTIVE TO PROCEED WITH A CHANGE THAT MAY AFFECT THE CONTRACT PRICE OR THE CONTRACT TIME. A CHANGE ORDER, IF ANY, SHOULD BE CONSIDERED PROMPTLY.

CASCADE MINE DRAINAGE

DSL-AMRB 91-001
Work Directive Change I - Attachment I

Item No.	Bid Item No. If Applicable	Description	Quantity	Unit	Unit Cost	Total Cost
1	17	(CLEANOUT Drain Pipe, 4"	300	LF	1.70 ~~8.00~~	~~$ 510.00~~ ~~$2,400.00~~
2	18	Perforated Pipe, 4"	30	LF	9.00	270.00
3	20	Drain Pipe Anchors	3	EA	100.00	~~0~~ ~~000.00~~
4	21	Pipe Cleanout Assembly	3	EA	75.00	225.00
5	22	Appurtenances, 4" Type 1	1	EA	88.00	88.00
6	23	Appurtenances, 4" Type 2	7	EA	86.00	602.00
7	29	Close Mine Opening - Adit	1	EA	750.00	750.00
8	-	Rental Rate, CAT D-7 Dozer (Time used to hold excavator on slope to dig trench)	10	HR	80.00	~~0~~ ~~800.00~~
		TOTAL				~~$5,435.00~~

~~3545.00~~
2445.00

RBM 8/23/

8·25

Signed _____

WORK DIRECTIVE CHANGE

(Instructions on Reverse Side) No. Two

PROJECT: Cascade Mine Drainage

DATE OF ISSUANCE: Apr 24, 1992

CONTRACTOR: Sharbono Construction
1826 N Last Chance Gulch
Helena MT 59601

OWNER: Department of State Lands,
Abandoned Mine Reclamation Bureau

MONT A/E or DSL-AMRB: 91-001

CONTRACT FOR: Schedule 1, Base Bid

ENGINEER: Robert Peccia & Associates

You are directed to proceed promptly with the following change(s):

Description: 1) Hand close adit subsidence at Centerville "C" site - agreed price $3000.00
2) Place Limestone Veneer at Centerville "C" site - unit cost same as Limestone Mix With Peat (approx 7 CY x $20.00 = $140.00)
3) Contract time extension - 10 days.

Purpose of Work Directive Change: 1) Close newly found adit subsidence.
2) Reclaim acidic seep not intercepted by collector system with limestone veneer.
3) Provide time to complete items 1 & 2, and compensate for 4 weather days since end of winter shutdown.

Attachments: (list documents supporting change)
Change supported by field visit by DSL-AMRB and construction observation records.

If a claim is made that the above change(s) have affected Contract Price or Contract Time, any claim for a Change Order based thereon will involve one of the following methods of determining the effect of the change(s).

Method of determining change in Contract Price:

- ☐ Time and Materials
- ☒ Unit Prices
- ☐ Cost Plus Fixed Fee
- ☒ Other MUTUAL AGREEMENT

Estimated increase ~~(decrease)~~ in Contract Price: $ 3140 00. If the change involves an increase, the estimated amount is not to be exceeded without further authorization.

Method of determining change in Contract Time:

- ☐ Contractor's Records
- ☒ Engineer's Records
- ☒ Other MUTUAL AGREEMENT

Estimated increase ~~(decrease)~~ in Contract Time: 10 days. If the change involves an increase, the estimated time is not to be exceeded without further authorization.

RECOMMENDED: Robert Peccia & Associates

By: Robert B Motson 4/24/92
Engineer

ACCEPTED: Sharbono Construction

By Lauren L Sharbono

AUTHORIZED: Dept of State Lands - AMRB

By John Kosta 4/27/92
Owner

WORK DIRECTIVE CHANGE

INSTRUCTIONS

A. GENERAL INFORMATION

This document was developed for use in situations involving changes in the Work which, if not processed expeditiously, might delay the Project. These changes are often initiated in the field and may affect the Contract Price or the Contract Time. This is not a Change Order, but only a directive to proceed with Work that may be included in a subsequent Change Order.

For supplemental instructions and minor changes not involving a change in the Contract Price or the Contract Time, a Field Order may be issued.

B. COMPLETING THE WORK DIRECTIVE CHANGE

Engineer initiates the form, including a description of the items involved and attachments.

Based on conversations between Engineer and Contractor, Engineer completes the following:

METHOD OF DETERMINING CHANGE, IF ANY, IN CONTRACT PRICE: Mark the method to be used in determining the final cost of Work involved and the net effect on the Contract Price. If the change involves an increase in the Contract Price and the estimated amount is approached before the additional or changed work is completed, another Work Directive Change must be issued to change the time or Contractor may stop the changed Work when the estimated time is reached. If the Work Directive Change is not likely to change the Contract Price, the space for estimated increase (decreased) should be marked "Not Applicable".

METHOD OF DETERMINING CHANGE, IF ANY, IN CONTRACT TIME: Mark the method to be used in determining the change in Contract Time and the estimated increase or decrease in Contract Time. If the change involves and increase in the Contract Time and the estimated time is approached before additional or changed Work is completed, another Work Directive Change must be issued to change the time or Contractor may stop the changed Work when the estimated time is reached. If the Work Directive Change is not likely to change the Contract Time, the space for estimated increase (decrease) should be marked "Not Applicable".

Once Engineer has completed and signed the form, all copies should be sent to Owner for authorization because Engineer alone does not have authority to authorize changes in Price or time. Once authorized by Owner, a copy should be sent by Engineer to Contractor.

Once the Work covered by this directive is completed for final cost and time determined, Contractor should submit documentation for inclusion in a Change Order.

THIS IS A DIRECTIVE TO PROCEED WITH A CHANGE THAT MAY AFFECT THE CONTRACT PRICE OR THE CONTRACT TIME. A CHANGE ORDER, IF ANY, SHOULD BE CONSIDERED PROMPTLY.

WORK DIRECTIVE CHANGE

(Instructions on Reverse Side) No. 3

PROJECT: **Cascade Mine Drainage**

DATE OF ISSUANCE: **7/27/92**

CONTRACTOR: **Sharbono Construction**
(Name, Address) **1826 N. Main**
Helena, MT 59601

OWNER: **Department of State Lands - Abandoned Mine Reclamation Bureau**

MONT A/E or DSL-AMRB: **91-001**

CONTRACT FOR: **Schedule 1**

ENGINEER: **Robert Peccia & Associates**

You are directed to proceed promptly with the following change(s):

Description: **Provide all equipment, labor and materials to cise a mine subsidence at Belt, Montana. Work includes mobilization, exploratory excavation, import backfill, coversoil, fertilize seed and mulch.**

Purpose of Work Directive Change: **Close mine subsidence.**

Attachments: (list documents supporting change) **Technical Specifications 501, 430, 203, 310, 320, 330.**

If a claim is made that the above change(s) have affected Contract Price or Contract Time, any claim for a Change Order based thereon will involve one of the following methods of determining the effect of the change(s).

Method of determining change in Contract Price:

- ☐ Time and Materials
- ☐ Unit Prices
- ☐ Cost Plus Fixed Fee
- ☒ Other Quote

Estimated increase (decrease) in Contract Price: $ 4865 00. If the change involves an increase, the estimated amount is not to be exceeded without further authorization.

Method of determining change in Contract Time:

- ☐ Contractor's Records
- ☒ Engineer's Records
- ☐ Other _____

Estimated increase (decrease) in Contract Time: 3 days. If the change involves an increase, the estimated time is not to be exceeded without further authorization.

RECOMMENDED: **Robert Peccia & Associates**

By: _____
Engineer

ACCEPTED: **Sharbono Construction**

By: _____
Contractor

AUTHORIZED: **Department of State Lands - AMRB**

By _____
Owner

RECEIVED
JUL 17 1991
STATE LANDS

CHANGE ORDER

ORDER NO: 1

PROJECT TITLE: Cascade Mine Drainage - Schedule 2 - Base Bid

MONT A/E or DSL-AMRB: 91-001

CONTRACT DATE: 7/19/91 Date of Award

OWNER: Department of State Lands - Abandoned Mine Reclamation Bureau

CONTRACTOR: Ed Boland Construction Inc.

Change Orders must be accompanied by an itemized cost breakdown. You are hereby requested to comply with the following changes from the Contract Documents. (Show separate costs for materials, labor, equipment, and miscellaneous. Show percent where applicable.)

ITEM NO.	DESCRIPTION OF CHANGES - ESTIMATED QUANTITIES & UNITS	COST OF CHANGES					TOTAL COST
		MAT'LS.	LABOR	EQUIP.	MISC.	TOTAL UNIT COST	
1	Decrease wetland planting density, affects bid item No. 2, transplant wetland vegetation, results in decreased unit and total price.	--	--	--	--	(1.05)	(38,325)
					TOTAL COST - MATERIALS, LABOR, EQUIPMENT & MISC.		($38,325)
					OVERHEAD & PROFIT @ _____%		--
					GRAND TOTAL - THIS CHANGE ORDER		($38,325)

Original Contract Price	$61,625.00
Current Contract Price Adjusted by Previous Change Order	$61,625.00
Cost this Change Order (+ or -)	- $38,325.00
New Contract Price including this Change Order	$23,300.00

The completion date as set forth in the Contract Documents shall be (unchanged, increased, decreased) by 0 calendar days.

The date for completion of all work will be 10/21/91.

Description and Justification for Change:

1. Decrease wetland planting density. Change special provision 3.11 (d)(5) page SP-8, to read, density of 1 plant per 2 square feet. Effectively reduces number of estimated plants from 2 x 36,500 = 73,000 to 0.5 x 36,500 = 18,250. A per plant cost of $0.90 and the decreased density reduces the unit price of Schedule 2 - Base Bid, Item 2, transplant wetland vegetation (sf) from $1.50 to $0.45. The bid total price for this item ($1.50 x 36,500) = $54,750.00 is reduced to ($0.45 x 36,500) = $16,425.00. Therefore the total price is $38,325.00 ($54,750.00 - $16,425.00) less than originally bid.

SURETY CONSENT

The Surety hereby consents to the aforementioned Contract Change Order and agrees that its bond or bonds shall apply and extend to the Contract as thereby modified or amended per this Change Order. The Principal and the Surety further agree that on or after execution of this consent, the penalty of the applicable Performance Bonds or Bonds is hereby increased by $_____ (100% of the Change Order amount) and the penalty of the applicable Labor and Material Bond or Bonds is hereby increased by $_____ (100% of the Change Order amount).

COUNTERSIGNED BY MONTANA RESIDENT AGENT

SURETY

_____ _____

_____ By: _____

Seal

Recommended by: Robert B Morton — Engineer — 7/16/91 — Date

Accepted by: Ed Bedard — Contractor — 7/16/91 — Date

Approved by: Larry Marshall — Owner — 7/17/91 — Date

WORK DIRECTIVE CHANGE

(Instructions on Reverse Side) No. 1

PROJECT: **Cascade Mine Drainage**

DATE OF ISSUANCE: **7/27/92**

CONTRACTOR: **Bolland Construction**
(Name, Address) **2608 9th Ave. North**
Great Falls, MT 59401

OWNER: **Department of State Lands - Abandoned Mine Reclamation Bureau**

MONT A/E or DSL-AMRB: **91-001**

CONTRACT FOR: **Schedule 2**

ENGINEER: **Robert Peccia & Associates**

You are directed to proceed promptly with the following change(s):

Description: **Provide all equipment, labor and materials to modify and repair piping at the French Coulee Site. Work includes mobilization, excavation and materials installation, re: 1) 6" Clay Pipe 2) 8" PVC Main and 3) Broken Riser Pipe Cleanout.**

Purpose of Work Directive Change: **Modifications and repair of French Coulee piping.**

Attachments: (list documents supporting change) **- See Attached**

If a claim is made that the above change(s) have affected Contract Price or Contract Time, any claim for a Change Order based thereon will involve one of the following methods of determining the effect of the change(s).

Method of determining change in Contract Price:

- ☐ Time and Materials
- ☐ Unit Prices
- ☐ Cost Plus Fixed Fee
- ☒ Other Quote

Estimated increase (decrease) in Contract Price: $ 2710 00. If the change involves an increase, the estimated amount is not to be exceeded without further authorization.

Method of determining change in Contract Time:

- ☐ Contractor's Records
- ☒ Engineer's Records
- ☐ Other _____

Estimated increase (decrease) in Contract Time: 3 days. If the change involves an increase, the estimated time is not to be exceeded without further authorization.

RECOMMENDED: **Robert Peccia & Associates**

By: Robert B Morton
Engineer

AUTHORIZED: **Department of State Lands - AMRB**

By John Lovell
Owner

ACCEPTED: **Bolland Construction**

By: Bryan L Bolland
Contractor

WORK DIRECTIVE CHANGE

INSTRUCTIONS

A. GENERAL INFORMATION

This document was developed for use in situations involving changes in the Work which, if not processed expeditiously, might delay the Project. These changes are often initiated in the field and may affect the Contract Price or the Contract Time. This is not a Change Order, but only a directive to proceed with Work that may be included in a subsequent Change Order.

For supplemental instructions and minor changes not involving a change in the Contract Price or the Contract Time, a Field Order may be issued.

B. COMPLETING THE WORK DIRECTIVE CHANGE

Engineer initiates the form, including a description of the items involved and attachments.

Based on conversations between Engineer and Contractor, Engineer completes the following:

METHOD OF DETERMINING CHANGE, IF ANY, IN CONTRACT PRICE: Mark the method to be used in determining the final cost of Work involved and the net effect on the Contract Price. If the change involves an increase in the Contract Price and the estimated amount is approached before the additional or changed work is completed, another Work Directive Change must be issued to change the time or Contractor may stop the changed Work when the estimated time is reached. If the Work Directive Change is not likely to change the Contract Price, the space for estimated increase (decreased) should be marked "Not Applicable".

METHOD OF DETERMINING CHANGE, IF ANY, IN CONTRACT TIME: Mark the method to be used in determining the change in Contract Time and the estimated increase or decrease in Contract Time. If the change involves and increase in the Contract Time and the estimated time is approached before additional or changed Work is completed, another Work Directive Change must be issued to change the time or Contractor may stop the changed Work when the estimated time is reached. If the Work Directive Change is not likely to change the Contract Time, the space for estimated increase (decrease) should be marked "Not Applicable".

Once Engineer has completed and signed the form, all copies should be sent to Owner for authorization because Engineer alone does not have authority to authorize changes in Price or time. Once authorized by Owner, a copy should be sent by Engineer to Contractor.

Once the Work covered by this directive is completed for final cost and time determined, Contractor should submit documentation for inclusion in a Change Order.

THIS IS A DIRECTIVE TO PROCEED WITH A CHANGE THAT MAY AFFECT THE CONTRACT PRICE OR THE CONTRACT TIME. A CHANGE ORDER, IF ANY, SHOULD BE CONSIDERED PROMPTLY.

ROBERT
PECCIA
& ASSOCIATES

Civil, Transportation
& Environmental
Engineers

July 1, 1992

Barry Bolland
Ed Bolland Construction Inc.
2608 9th Ave North
Great Falls, MT 59401

RE: French Coulee/Cascade Mine Drainage, AMRB 91-001

Dear Barry:

As discussed with you today, we are interested in obtaining a quote from you on modifications to the French Coulee project. Enclosed is a copy of the modification drawings and the problem description. Please make yourself familiar with this information and next week we can discuss any questions you may have.

Sincerely,

ROBERT PECCIA & ASSOCIATES

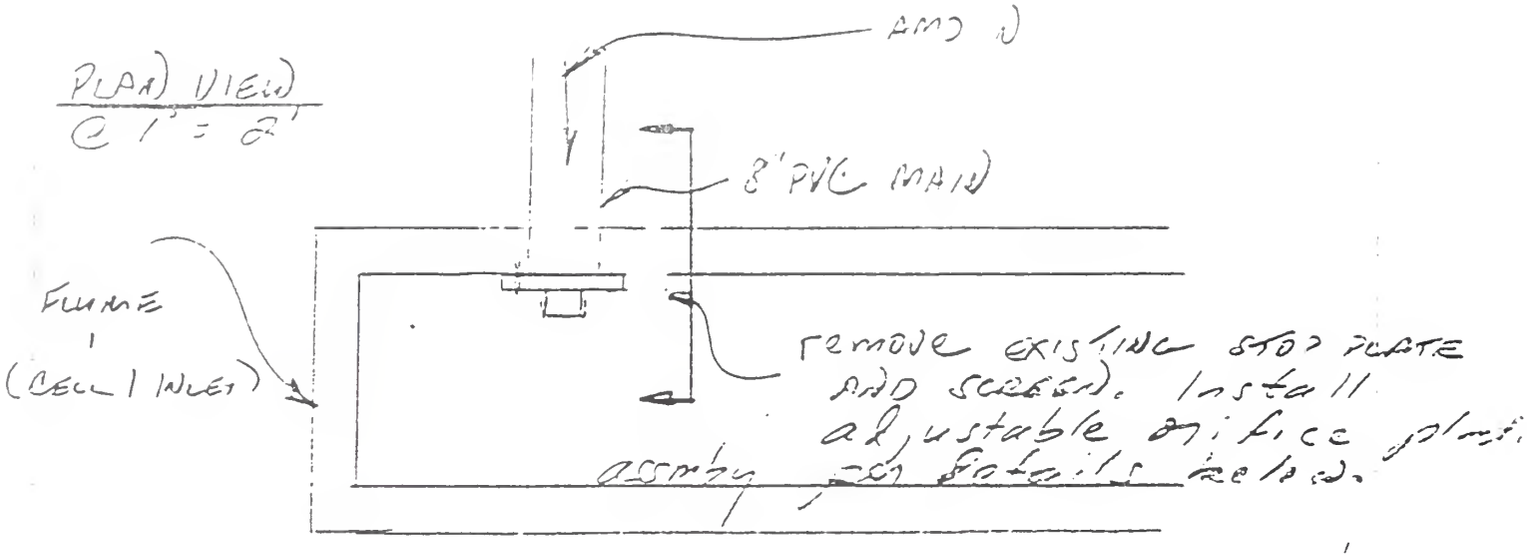
Bob Morton

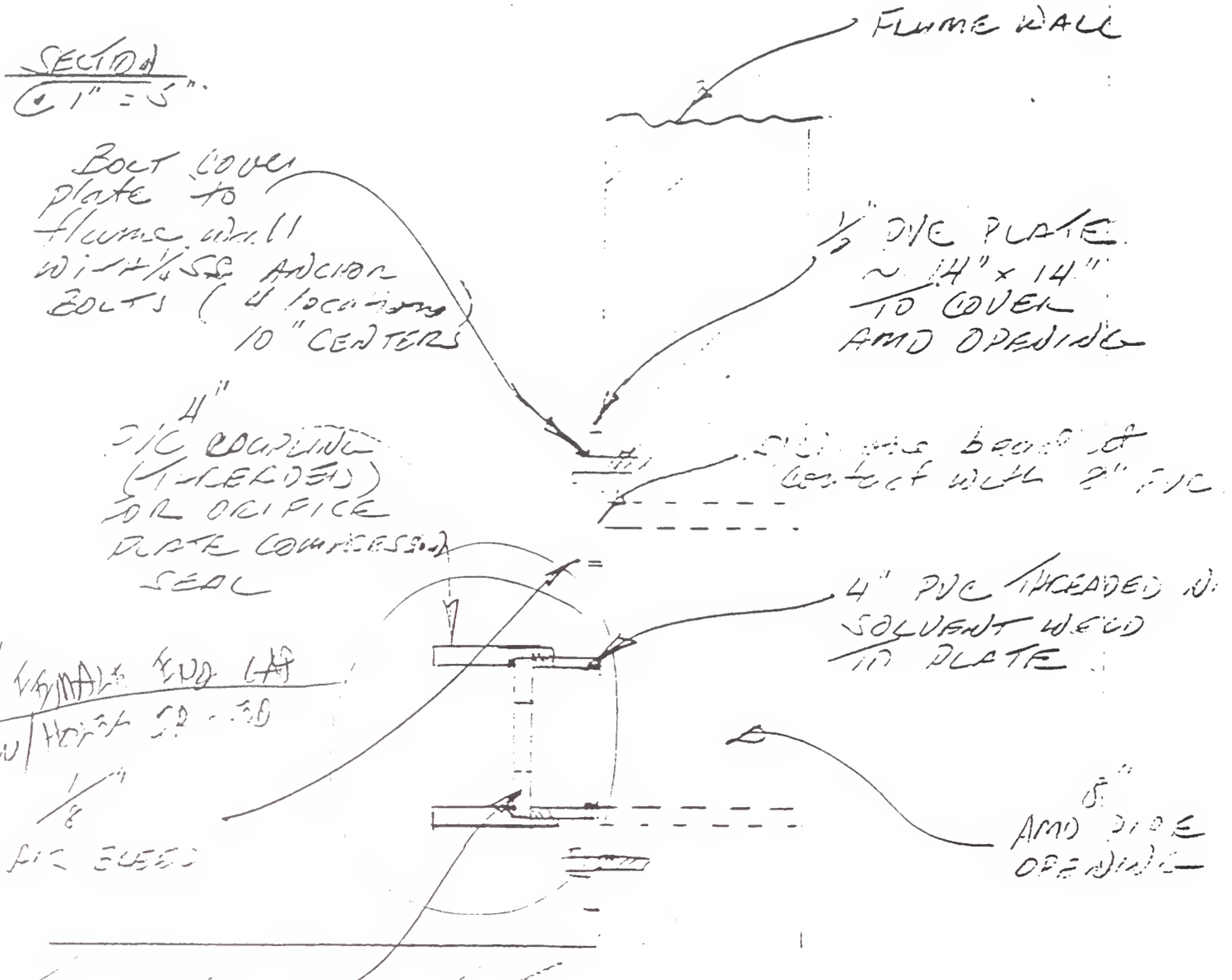
Robert B. Morton
Reclamation Scientist

cc: John Koerth, DSL-AMRB

P.O. Box 5653
825 Custer
Helena, Montana 59604
(406) 442-8160
FAX (406) 443-6324

SA-002 DISCHARGE ORIFICE T. HUDSON 11/27/02
INSTALLATION


PLAN VIEW
@ 1" = 2"
AMD
8" PVC MAIN
FLUME
(CELL 1 INLET)
REMOVE EXISTING STOP PLATE AND SCREEN. INSTALL ADJUSTABLE ORIFICE PLATE ASSEMBLY, SEE DETAILS BELOW.


SECTION
@ 1" = 5"
FLUME WALL
BOLT COVER PLATE TO FLUME WALL WITH ½" SS ANCHOR BOLTS (4 LOCATIONS) 10" CENTERS
½" PVC PLATE ~ 14" x 14" TO COVER AMD OPENING
4" PVC COUPLING (THREADED) FOR ORIFICE PLATE COMPRESSION SEAL
SEAL MUST BE WATER TIGHT WITH 2" PVC
4" PVC THREADED W/ SOLVENT WELD TO PLATE
4" NOMINAL END CAP W/ HEIGHT OF 3.50
½" PVC SLEEVE
8" AMD PIPE OPENING
PROVIDE 3 INTERCHANGEABLE (~ 4½" OD x ½" THICK PVC ORIFICE PLATES FOR CONSTRUCTION FIT CENTER DRILLED FOR ORIFICE DIAMETERS 2" 1½" AND 1"

RECOMMENDATIONS FOR FRENCH COULEE WETLAND VALVE INSTALLATIONS

Description of problem:

The French Coulee Wetland began receiving AMD in July 1991. For several months the wetlands were subject to some minor periodic upsets due to short circuiting of flow but generally resulted in significant improvement of water quality during the short period of operation. With the onset of winter weather freeze-up produced a condition in which substrate was largely by-passed in at least two cells causing a significant deterioration in effluent water quality which could not be remedied through immediate maintenance action. A decision was made to shut down the wetland, evaluate the situation and determine a course of action in the spring when ice would no longer be a factor.

The wetland 8 inch PVC main AMD pipeline was tied into an existing manhole at the north side of Anaconda Road about 18 inches below the road surface. Prior to wetland construction, this manhole had collected AMD from two areas, combined them into a single 6 inch clay pipe which then carried the flow approximately 800 feet to the northwest to a ditch and culvert passing under the BN tracks and flowing into a common collection ditch for all AMD in the area. The old 6 inch pipeline was diverted simply by grouting it off. The new pipeline was installed as a gravity pipeline and, like the old one, was not equipped for shutoff. Thus it was necessary to reopen the 6 inch clay pipe and grout off the new one when problems arose. Since the wetland is liable to continue to have operational difficulties from time to time which require its isolation and since data indicate that its overall performance may be deteriorating, a simpler way is needed to isolate the wetland and divert flow back to the old clay pipe.

A second area of concern relates to flow control. The volume of flow, acidity and iron content is somewhat higher than originally projected for design purposes. Performance data suggest that, although early treatment results were good, the wetland probably will not be capable of sustaining those treatment results indefinitely once inherent neutralization potential and exchange capacity is exhausted. The wetland will become overloaded at current flow rates. Thus, a way is needed to adjust the existing flows to some maximum value that the wetland can sustain and divert the rest.

Alternatives considered:

6 inch clay pipe: In all cases, the old 6 inch clay pipe should act as a failsafe device that activates automatically if the wetland main is closed, partially restricted for purposes of flow control or restricted by blockage. This can be done simply by inserting a PVC 45° ell (4 or 5 inch ID for best fit) into the clay pipe as it leaves the manhole, setting the elevation of the open end at some minimum height above the opening of the wetland PVC 8 inch main and grouting it into place. A sketch of installation details is provided in drawing SK-001. Estimated cost for this installation is $

8 inch PVC main: A surplus 8 inch PVC butterfly valve is available from the construction project. This valve can be used for a shutoff valve. It is not likely to be an effective control device since it is grossly oversized for the volume of flow desired and butterfly valves have poor flow control characteristics anyway. Five locations were considered for installation of this valve. Our recommendation is to install the valve outside the manhole but off Anaconda Road and provide an actuator extension with a riser to the surface for valve opening and closing. The riser would be equipped with a locking cap as are other buried valves on the project. The valve could be installed in a new manhole to facilitate valve maintenance, however the valve will function only as an on/off device and maintenance requirements are not expected to be frequent enough to justify the added costs. This alternate will provide an inexpensive, effective and convenient way to provide for wetland isolation when required. The advantages, disadvantages and costs of each location are summarized in the Table I. Estimated cost for the preferred alternative is $

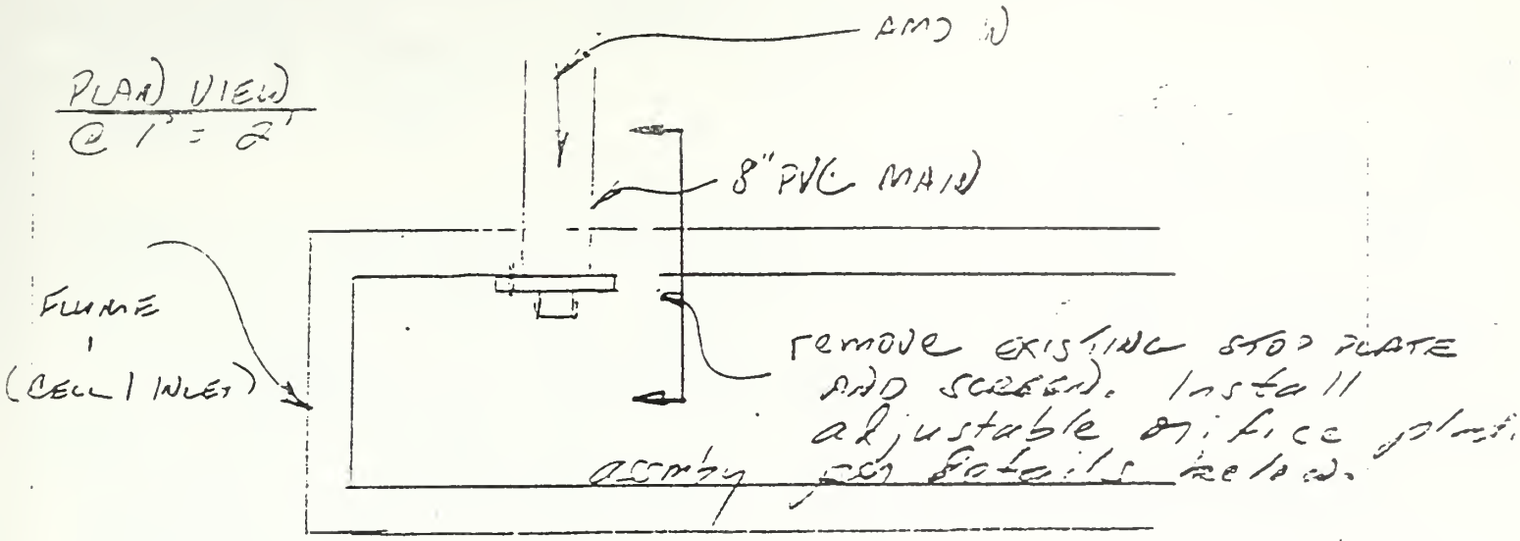
DROP FOR OK 7/22/92 →

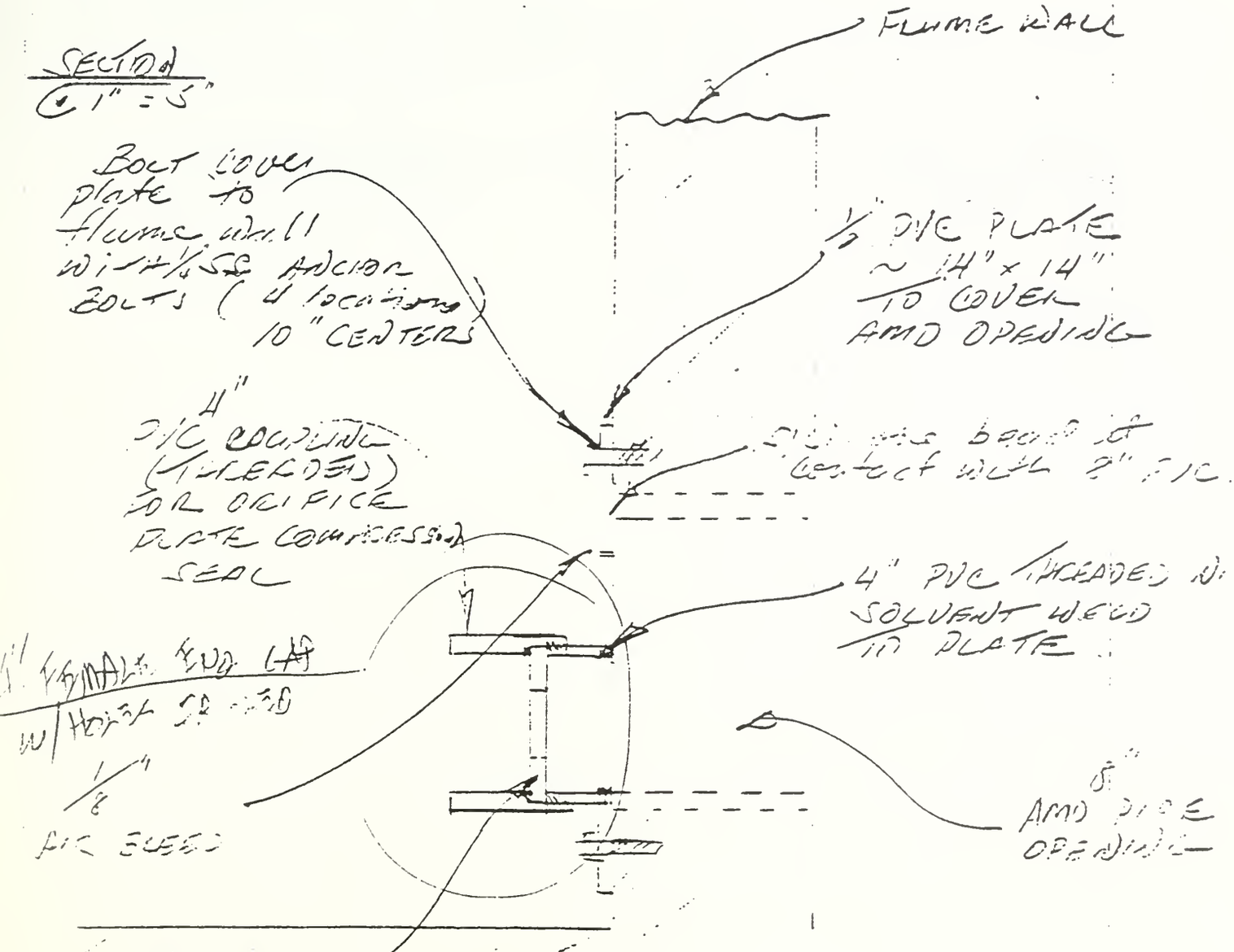
Flow control device: All of the shutoff valve locations above were considered from the standpoint of utilizing the valve for flow adjustment as well. However, the size of the valve and limited working head available at the preferred location are not conducive to adequate flow control. We recommend installing a second device properly sized for flow adjustment in the 5 to 10 gpm range and locating it at the discharge end of the 8 inch PVC main where the effect of adjustments can be immediately measured in the Parshall flume and where there will be adequate working head to provide a suitable level of control. Valves were considered for this duty but the same effect can be achieved at less cost with an adjustable orifice. A drawing of a proposed installation is shown in SK-002. There is the potential for winter freeze-up with this device but it is anticipated that the AMD will be warm enough and flowing briskly enough at the outlet that this will not occur. The opportunity for pluggage is also greater at the orifice restriction. However, bacterial fouling, the most likely cause of fouling in this highly acidic flow, generally is observed where oxygen is readily available. The discharge should remain flooded thereby offering less opportunity for oxygen transfer and less subject to bacterial growth than the current installation. Estimated cost for this modification is $

<u>Recommended action:</u>

Install the surplus 8 inch butterfly valve in the 8 inch PVC main as a shutoff valve only. The valve should be installed with a valve stem extension to the surface (approximately 5 feet) in an 8 inch PVC riser with locking cap and located near the existing manhole but off the side of Anaconda Road. A plug with adjustable orifice should be installed at the discharge end of the 8 inch PVC main as it enters Cell 1 to provide a method for flow adjustment (SK-002). Once these installations are complete, the grout plug should be removed from the 8 inch main and the overflow device should be installed in the 6 inch clay pipe as shown in SK-001.

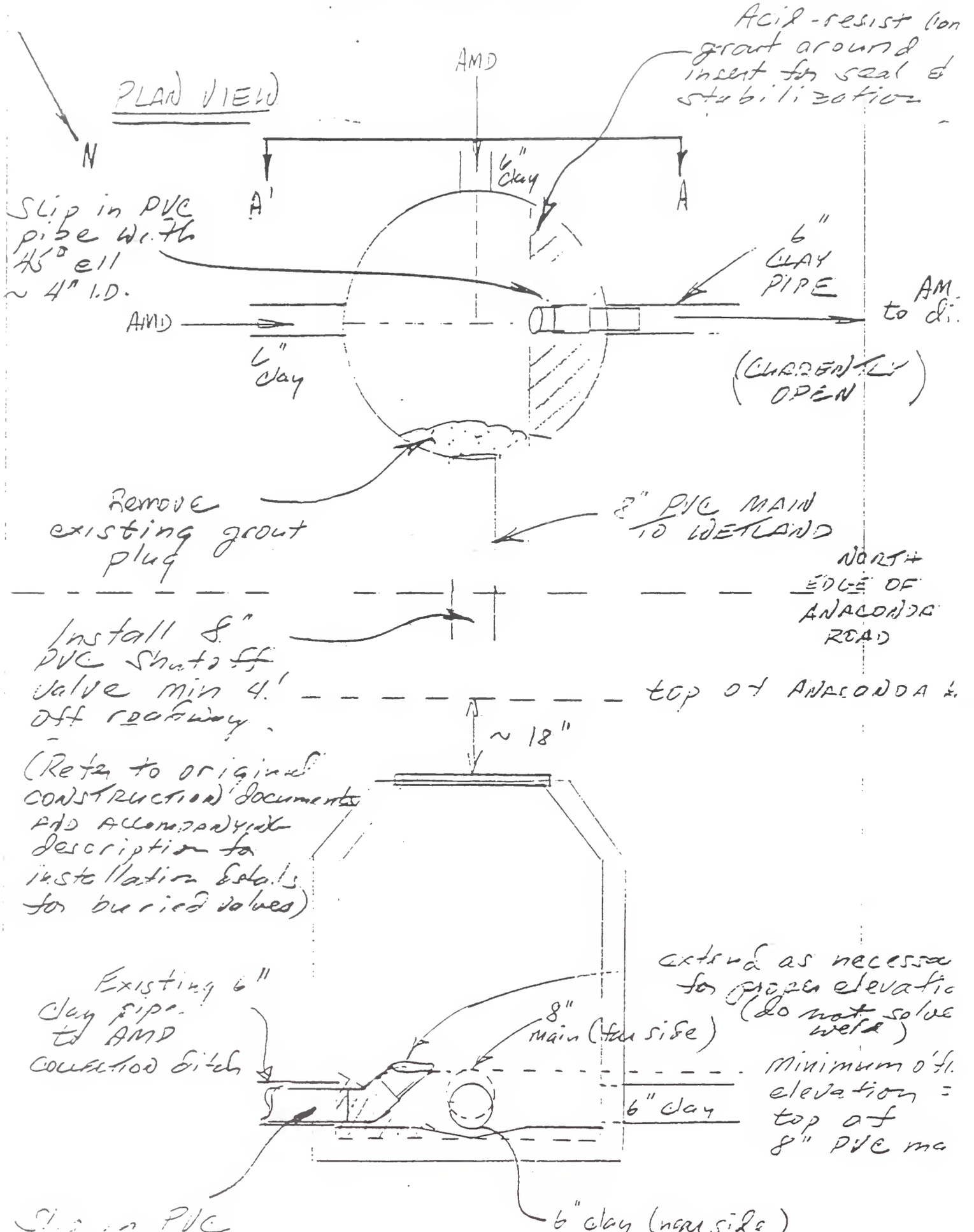
CK - 002 DISCHARGE ORIFICE T. HUDSON 11/27/02
INSTALLATION




SECTION
@ 1" = 5"
FLUME WALL
BOLT COVER PLATE TO FLUME WALL WITH 1/4" SS ANCHOR BOLTS (4 LOCATIONS 10" CENTERS
1/2" PVC PLATE ~ 14" x 14" TO COVER AMD OPENING
4" PVC COUPLING (THREADED) FOR ORIFICE PLATE CONNECTION SEAL
4" PVC THREADED W/ SOLVENT WELD TO PLATE
1/8" PVC SHEET
AMD OPENING

PROVIDE 3 INTERCHANGEABLE (~ 4 1/2" OD x 1/4" THICK PVC ORIFICE PLATES for CONSTRUCTION FIT CENTER DRILLED FOR ORIFICE DIAMETERS 2", 1 1/2" and 1".

SK - CC1 MANHOLE MODIFICATIONS J. HUDSON 4/24/92


PLAN VIEW
N
AMD
A'
A
6" clay
Acid-resistant grout around insert for seal & stabilization
Slip in PVC pipe with 45° ell ~ 4" I.D.
6" CLAY PIPE
AMD
6" clay
(CURRENTLY OPEN)
Remove existing grout plug
8" PVC MAIN TO WETLAND
NORTH EDGE OF ANACONDA ROAD
Install 8" PVC shut-off valve min 4' off roadway. (Refer to original construction documents and accompanying description for installation details for buried valves)
top of ANACONDA R
~ 18"
extend as necessary for proper elevation (do not solve water)
Existing 6" clay pipe to AMD collection ditch
8" main (this side)
minimum o'fl. elevation = top of 8" PVC ma
6" clay
6" clay (near side)
Slip-in PVC pipe with 45° ell ~ 4" I.D.

ELEVATION A - A'

SEP 2 - 1992

ROBERT [illegible]

CHANGE ORDER

ORDER NO. 2 - Final

PROJECT TITLE: Cascade Mine Drainage - Schedule 2 - Base Bid

MONT A/E or DSL-AMRB: 91-001

CONTRACT DATE: Aug, 26, 1991 Date of Agreement

OWNER: Mt Dept. of State Lands - Abandoned Mine Reclamation Bureau

CONTRACTOR: Ed Bolland Construction, Inc.

Change Orders must be accompanied by an itemized cost breakdown. You are hereby requested to comply with the following changes from the Contract Documents. (Show separate costs for materials, labor, equipment, and miscellaneous. Show percent where applicable.)

ITEM NO.	DESCRIPTION OF CHANGES - ESTIMATED QUANTITIES & UNITS	COST OF CHANGES					TOTAL COST
		MAT'LS.	LABOR	EQUIP.	MISC.	TOTAL UNIT COST	
1	Bid Item 2. Transplant Wetland Vegetation - Increase Quantity from total 36,500 SF to 44,600 SF (22,300 total cattail plants).	--	--	--	--	$0.45/SF ($0.90/ plant)	3645.00
2	Work Directive Change 1. Modifications and repair of French Coulee Piping - Increase project amount by 1 LS @ $2,710.00.	--	--	--	--	$2,710.00	2710.00
						TOTAL COST - MATERIALS, LABOR, EQUIPMENT & MISC.	$6,355.00
						OVERHEAD & PROFIT @ ____%	__0__
						GRAND TOTAL - THIS CHANGE ORDER	$6,355.00

Original Contract Price	$61,625.00
Current Contract Price Adjusted by Previous Change Order	$23,300.00
Cost this Change Order (+ or -)	+ $6,355.00
New Contract Price including this Change Order	$29,655.00

The completion date as set forth in the Contract Documents shall be (unchanged, increased, decreased) by 18 calendar days.

The date for completion of all work will be August 12, 1992.

Description and Justification for Change:

1. Bid Item 2. Transplant Wetland Vegetation - Increase in quantity reconciles bid quantities to reflect actual quantities installed.

2. Work Directive Change 1. Modifications and repair of French Coulee Piping - Increase in project amount by 1 LS @ quoted cost, see Work Directive 1.

SURETY CONSENT

The Surety hereby consents to the aforementioned Contract Change Order and agrees that its bond or bonds shall apply and extend to the Contract as thereby modified or amended per this Change Order. The Principal and the Surety further agree that on or after execution of this consent, the penalty of the applicable Performance Bonds or Bonds is hereby increased by $6,355.00--- (100% of the Change Order amount) and the penalty of the applicable Labor and Material Bond or Bonds is hereby increased by $ 6,355.00--- (100% of the Change Order amount).

COUNTERSIGNED BY MONTANA RESIDENT AGENT	SURETY
FLYNN INSURANCE AGENCY	GREAT AMERICAN INSURANCE COMPANY
Gordon D. McManus	By: Lisa W. Anderson
GORDON D. MCMANUS	LISA W. ANDERSONSeal

Recommended by: Robert Peccia & Assoc. Robert B Nutter 8/27/92
Engineer Date

Accepted by: Ed Bolland Const [signature] 8/28/92
Contractor Date

Approved by: DSL-AMRB Vicki R Andersen 9/22/92
Owner Date

Attachment C. Pay Requests

RECEIVED
SEP 25 1991
ROBERT PECCIA & ASSOCIATES

PAYMENT REQUEST NO. ONE

FROM 7/20/91 TO 8/27/91

PROJECT TITLE: CASCADE MINE DRAINAGE

LOCATION: CENTERVILLE "C"/STOCKETT SE MONT A/E or DSL-AMRB: 91-001

NAME OF CONTRACTOR: SHARBONO CONSTRUCTION, INC.

ADDRESS: 1826 N. MAIN, HELENA, MT 59601

SUMMARY OF PROJECT STATUS

Amount of Original Contract		$ 483,458:00
Change Order No. ____	$	
Change Order No. ____	$	
Change Order No. ____	$	
Amount of Approved Change Order(s)		$ -
TOTAL CONTRACT AMOUNT		$ 483,458.00

Pay Request No.	Amount of Request
1	62,065.71

RBM
9/11/91

Total Contract Amount Completed to Date	$ ~~74,857.65~~	68961 90
Less Retainage (10 %)	$ ~~7,485.77~~	6896 19
TOTAL AMOUNT EARNED TO DATE	$ ~~67,371.88~~	62065 71
Less Previous Payments	$ -0-	
AMOUNT DUE THIS PAYMENT	$ ~~67,371.88~~	62065 71
Less 1% Tax	$ ~~673.72~~	620 66
TOTAL DUE CONTRACTOR	$ ~~66,698.16~~	61445 05

I certify that this claim is correct and just in all respects and that payment or credit has not been received.

SHARBONO CONSTRUCTION, INC.
Contractor

By [signature]

Date 8/27/91

RECOMMENDED BY:

ROBERT PECCIA & ASSOC.
Engineer

By Robert B Morton

Date 9/11/91

APPROVED BY:

Dept. of State Lands, Abandoned Mine Reclamation Bureau
Owner

By [signature]

Date September 23, 1991

CASCADE MINE DRAINAGE
DSL-AMRB NO. 91-001
PAY REQUEST NO. ONE

Item No.	Description	Contr Qty		Contr Unit Price	Prev Qty Req'd	Curr Qty Compl	Total Qty Compl To Date	Total Contract Amount Compl To Date	Amount Due This Payment
1	Mobilization, Bonding and Insurance	LS		10,000.00	0	~~96~~ ~~92%~~ ~~45.6~~ ~~41%~~	~~96~~ ~~92%~~ ~~45.6~~ ~~41%~~	~~9600.00~~ ~~9,170.00~~ ~~4130.00~~ ~~5,220.00~~	~~9600.00~~ ~~9,170.00~~ ~~4130.00~~ ~~5,220.00~~
2	Site Access	LS		12,880.00	0				
3	Site Dewatering	LS		9,844.00	0	16% ~~30.3~~ ~~75%~~	16% ~~30.3~~ ~~75%~~	1,576.00 ~~4500.00~~ ~~16,875.00~~	1,576.00 ~~4500.00~~ ~~16,875.00~~
4	Site Earthwork	LS		31,400.00	0				
5	Fine Grading	LS		2,240.00	0	00%	00%	0.00	0.00
6	Bentonite Seal	71400	SF	0.39	0	0	0	0.00	0.00
7	Membrane Liner	57100	SF	0.49	0	0	0	0.00	0.00
8	Membrane Liner	19580	SF	1.40	0	0	0	0.00	0.00
9	Filter Gravel	1475	CY	20.00	0	0	0	0.00	0.00
10	Peat	1407	CY	35.00	0	0	0	0.00	0.00
11	Peat-DCW	1065	CY	35.00	0	0	0	0.00	0.00
12	Hay Bale Dikes	300	EA	5.00	0	0	0	0.00	0.00
13	Lime Application	5	AC	1,800.00	0	0	0	0.00	0.00
14	Stock Tank, 1000 gal	1	EA	2,500.00	0	0	0	0.00	0.00
15	Weir Outlet Structure	3	EA	800.00	0	0	0	0.00	0.00
16	Geocomposite	11000	SF	1.25	0	~~4105~~ ~~4200~~	~~4105~~ ~~4200~~	~~5131.25~~ ~~5,375.00~~	~~5131.25~~ ~~5,375.00~~
17	Drain Pipe, 4"	3650	LF	8.00	0	220	220	1,760.00	1,760.00
18	Perforated Pipe, 4"	2860	LF	9.00	0	~~441~~ ~~550~~	~~441~~ ~~550~~	~~3769.00~~ ~~5,850.00~~	~~3769.00~~ ~~5,850.00~~
19	18" PE Culvert	20	LF	40.00	0	0	0	0.00	0.00
20	Drain Pipe Concrete	34	EA	100.00	0	0	0	0.00	0.00
21	Pipe Cleanout Assmbly	64	EA	75.00	0	12	12	900.00	900.00
22	Appurt., 4" Type 1	28	EA	88.00	0	~~03~~	~~03~~	~~264.00~~ ~~0.00~~	~~264.00~~ ~~0.00~~
23	Appurt., 4" Type 2	102	EA	86.00	0	~~012~~	~~012~~	~~1032.00~~ ~~0.00~~	~~1032.00~~ ~~0.00~~
24	PVC Valves, 4"	10	EA	280.00	0	0	0	0.00	0.00
25	Service Hole, 72"	4	EA	2,790.00	0	~~21~~	~~21~~	~~2790.00~~ ~~5,580.00~~	~~2790.00~~ ~~5,580.00~~
26	Limestone Aggregate	270	EA	15.00	0	0	0	0.00	0.00
27	Cushion Fabric	6820	SY	2.85	0	0	0	0.00	0.00
28	Riprap	52	CY	40.00	0	0	0	0.00	0.00
29	Close Mine Opening-Adit	2	EA	750.00	0	0	0	0.00	0.00
30	Import Cover Soil	2800	CY	6.50	0	0	0	0.00	0.00
31	Fertilize and Seed	8	AC	950.00	0	0	0	0.00	0.00
32	Mulch	8	AC	650.00	0	0	0	0.00	0.00
33	Remove & Salvage Fence	5100	LF	0.35	0	2259	2259	790.65	790.65
34	Farm Fence(Type F-4M)	6420	LF	2.30	0	0	0	0.00	0.00
35	Farm Fence Gate, 16'	15	EA	70.00	0	0	0	0.00	0.00
36	Farm Fence(Type F-5M)	4295	LF	2.40	0	0	0	0.00	0.00
37	Erosion Contr.Mat.Vinyl	200	SY	7.50	0	0	0	0.00	0.00
38	Erosion Control Mat Biodegradable	2300	SY	5.25	0	0	0	0.00	0.00
	SUB TOTAL							45249.90	45249.90
	Material on Site (See attached schedule)	---		---	0.00	~~21,751.00~~ 23712.00	---	~~21,751.00~~ 23712.00	~~21,751.00~~ 23712.00
								~~74,857.65~~ 68961.90	~~74,857.65~~ 68961.90

ABM
9/11/91

SCHEDULE OF MATERIAL ON SITE

PROJECT TITLE: CASCADE MINE DRAINAGE
MONT A/E or DSL-AMRB: 91-001
CONTRACTOR: SHARBONO CONSTRUCTION. INC.

ITEM 16	Material Delivered	6.160.00	
	Material in Place	~~2.408.00~~	
	Material on Site	2299.00	~~3.752.00~~ 3861.00
ITEM 17	Material Delivered	4.584.00	
	Material in Place	240.00	
	Material on Site		4.344.00
ITEM 18	Material Delivered	1.575.00	
	Material in Place	~~293.00~~	
	Material on Site	288.00	~~1.282.00~~ 1287.00
ITEM 19	Material Delivered	240.00	
	Material in Place	0.00	
	Material on Site		240.00
ITEM 22	Material Delivered	2.133.00	
	Material in Place	~~0.00~~	
	Material on Site	63.00	~~2.133.00~~ 2070.00
ITEM 23	Material Delivered	4.318.00	
	Material in Place	~~0.00~~	
	Material on Site	73.00	~~4.318.00~~ 4245.00
ITEM 24	Material Delivered	1.717.00	
	Material in Place	0.00	
	Material on Site		1.717.00
ITEM 25	Material Delivered	7.931.00	
	Material in Place	~~3.966.00~~	
	Material on Site	1983.00	~~3.965.00~~ 5948.00
	TOTAL MATERIAL ON SITE (Invoices provided)		~~21.751.00~~ 23.712.00

RBM
9/11/91

Requested by: SHARBONO CONSTRUCTION. INC.

To be included in Payment Request No. ONE

RECEIVED

OCT 24 1991

STATE LANDS

PAYMENT REQUEST NO. TWO

FROM 8/28/91 TO 9/27/91

PROJECT TITLE: CASCADE MINE DRAINAGE

LOCATION: CENTERVILLE "C"/STOCKETT MONT A/E or DSL-AMRB: 91-001

NAME OF CONTRACTOR: SHARBONO CONSTRUCTION, INC.

ADDRESS: 1826 N. MAIN, HELENA, MT 59601

SUMMARY OF PROJECT STATUS

Amount of Original Contract		$ 483,458.00
Change Order No. 1	$ 139,151.90	
Change Order No. ____	$	
Change Order No. ____	$	
Amount of Approved Change Order(s)		$ 139,151.90
TOTAL CONTRACT AMOUNT		$ 622,609.90

Pay Request No.	Amount of Request
ONE	62,065.71
2	68,127.75

Total Contract Amount Completed to Date	$ 144,659.40
Less Retainage (10 %)	$ 14,465.94
TOTAL AMOUNT EARNED TO DATE	$ 130,193.46
Less Previous Payments	$ 62,065.71
AMOUNT DUE THIS PAYMENT	$ 68,127.75
Less 1% Tax	$ 681.28
TOTAL DUE CONTRACTOR	$ 67,446.47

I certify that this claim is correct and just in all respects and that payment or credit has not been received.

SHARBONO CONSTRUCTION, INC.
Contractor

By Delbert E. Sharbono

Date OCTOBER 11, 1991

RECOMMENDED BY:

ROBERT PELLIA & ASSOC.
Engineer

By Robert D. Morton

Date 10/21/91

APPROVED BY:

Dept. of State Lands, Abandoned Mine Reclamation Bureau
Owner

By FOR Edward C. Lund

Date Oct 28, 1991

CASCADE MINE DRAINAGE
DSL-AMRB NO. 91-001
PAY REQUEST NO. ONE

Item No.	Description	Contr Qty		Contr Unit Price	Prev Qty Req'd	Curr Qty Compl	Total Qty Compl To Date	Total Contract Amount Compl To Date	Amount Due This Payment
1	Mobilization, Bonding and Insurance	LS		10,000.00	9,600.00	00.0%	96.0%	9,600.00	0.00
2	Site Access	LS		12,880.00	6,130.00	31.4%	79.0%	10,175.20	4,045.20
3	Site Dewatering	LS		9,844.00	1,576.00	29.0%	45.0%	4,429.80	2,853.80
4	Site Earthwork	LS		31,400.00	9,507.00	00.0%	30.3%	9,507.00	0.00
5	Fine Grading	LS		2,240.00	0.00	00.0%	00.0%	0.00	0.00
6	Bentonite Seal	71400	SF	0.39	0	0	0	0.00	0.00
7	Membrane Liner	57100	SF	0.49	0	0	0	0.00	0.00
8	Membrane Liner	19580	SF	1.40	0	0	0	0.00	0.00
9	Filter Gravel	1475	CY	20.00	0	0	0	0.00	0.00
10	Peat	1407	CY	35.00	0	0	0	0.00	0.00
11	Peat-DCW	1065	CY	35.00	0	0	0	0.00	0.00
12	Hay Bale Dikes	300	EA	5.00	0	0	0	0.00	0.00
13	Lime Application	5	AC	1,800.00	0	0	0	0.00	0.00
14	Stock Tank, 1000 gal	1	EA	2,500.00	0	0	0	0.00	0.00
15	Weir Outlet Structure	3	EA	800.00	0	0	0	0.00	0.00
16	Geocomposite	11000	SF	1.25	4105	6895	11,000	13,750.00	8,618.75
17	Drain Pipe, 4"	3650	LF	8.00	220	1585	1,805	14,440.00	12,680.00
18	Perforated Pipe, 4"	2860	LF	9.00	641	2165	2,806	25,254.00	19,485.00
19	18" PE Culvert	20	LF	40.00	0	0	0	0.00	0.00
20	Drain Pipe Concrete	34	EA	100.00	0	0	0	0.00	0.00
21	Pipe Cleanout Assembly	64	EA	75.00	12	41	53	3,975.00	3,075.00
22	Appurt., 4" Type 1	28	EA	88.00	3	10	13	1,144.00	880.00
23	Appurt., 4" Type 2	102	EA	86.00	12	46	58	4,988.00	3,956.00
24	PVC Valves, 4"	10	EA	280.00	0	3	3	840.00	840.00
25	Service Hole, 72"	4	EA	2,790.00	1	1	2	5,580.00	2,790.00
26	Limestone Aggregate	270	EA	15.00	0	0	0	0.00	0.00
27	Cushion Fabric	6820	SY	2.85	0	0	0	0.00	0.00
28	Riprap	52	CY	40.00	0	0	0	0.00	0.00
29	Close Mine Opening-Adit	2	EA	750.00	0	0	0	0.00	0.00
30	Import Cover Soil	2800	CY	6.50	0	0	0	0.00	0.00
31	Fertilize and Seed	8	AC	950.00	0	0	0	0.00	0.00
32	Mulch	8	AC	650.00	0	0	0	0.00	0.00
33	Remove & Salvage Fence	5100	LF	0.35	2259	0	2,259	790.65	0.00
34	Farm Fence(Type F-4M)	6420	LF	2.30	0	0	0	0.00	0.00
35	Farm Fence Gate, 16'	15	EA	70.00	0	0	0	0.00	0.00
36	Farm Fence(Type F-5M)	4295	LF	2.40	0	0	0	0.00	0.00
37	Erosion Contr.Mat,Vinyl	200	SY	7.50	0	0	0	0.00	0.00
38	Erosion Control Mat Biodegradable	2300	SY	5.25	0	0	0	0.00	0.00
0 1	CO#1-see attached				0			11,323.75	11,323.75
	SUBTOTAL							115,797.40	70,547.50
	Material on Site (See attached schedule)	---		---	~~0~~ $ 23,712.00	0.00	---	28,862.00	5,150.00
								144,659.40	75,697.50

SCHEDULE OF MATERIAL ON SITE

PROJECT TITLE: CASCADE MINE DRAINAGE
MONT A/E or DSL-AMRB: 91-001
CONTRACTOR: SHARBONO CONSTRUCTION, INC.

ITEM 6	Material Delivered	7,392.00	
	Material in Place	0.00	
	Material on Site		7,392.00
ITEM 17	Material Delivered	4,584.00	
	Material in Place	2,267.00	
	Material on Site		2,317.00
ITEM 18	Material Delivered	1,575.00	
	Material in Place	1,545.00	
	Material on Site		30.00
ITEM 19	Material Delivered	240.00	
	Material in Place	0.00	
	Material on Site		240.00
ITEM 22	Material Delivered	2,133.00	
	Material in Place	990.00	
	Material on Site		1,143.00
ITEM 23	Material Delivered	4,714.00	
	Material in Place	2,455.00	
	Material on Site		2,259.00
ITEM 24	Material Delivered	1,717.00	
	Material in Place	515.00	
	Material on Site		1,202.00
ITEM 25	Material Delivered	7,700.00	
	Material in Place	3,850.00	
	Material on Site		3,850.00
ITEM 26	Material Delivered	6,984.00	
	Material in Place	0.00	
	Material on Site		6,984.00
ITEM 34	Material Delivered	1,653.00	
	Material in Place	0.00	
	Material on Site		1,653.00
ITEM 35	Material Delivered	609.00	
	Material in Place	0.00	
	Material on Site		609.00
ITEM 36	Material Delivered	1,183.00	
	Material in Place	0.00	
	Material on Site		1,183.00
	TOTAL MATERIAL ON SITE (Invoices provided)		$28,862.00

Requested by: SHARBONO CONSTRUCTION, INC.

TO BE INCLUDED WITH PAY REQUEST NO. TWO

CASCADE MINE DRAINAGE
LSL-AMRB NO. 91-001 CHANGE ORDER #1
PAY REQUEST NO. TWO

tem o.	Description	Contr Qty	Contr Unit Price	Prev Qty Req'd	Curr Qty Compl	Total Qty Compl To Date	Total Contract Amount Compl To Date	Amount Due This Payment
E	INCREASE WETLAND SIZE							
.	Incr Qty-Site Earthwork							
	2350 CY @ $7.50/CY	LS	17,625.00	0.00	00.0%	00.0%	0.00	0.00
.	Incr Qty-Fine Grading							
	0.7 AC @ $1,867.00/AC	LS	1,306.90	0.00	00.0%	00.0%	0.00	0.00
.	Incr Qty-Bentonite Seal	12500	SF	0.39	0	0	0	0.00	0.00
.	Incr Qty-Membrane Liner	12500	SF	0.49	0	0	0	0.00	0.00
.	Incr Qty-Filter Gravel	1320	CY	20.00	0	0	0	0.00	0.00
.	Add Peat-OM (new item)	2375	CY	20.00	0	0	0	0.00	0.00
.	Incr Qty-Hay Bale Dikes	300	EA	5.00	0	0	0	0.00	0.00
.	Incr Qty-Weir Outlet Str.	1	EA	800.00	0	0	0	0.00	0.00
.	Incr Qty-Drain Pipe, 4"	30	LF	8.00	0	0	0	0.00	0.00
.	Incr Qty-Perf Pipe, 4"	50	LF	9.00	0	0	0	0.00	0.00
.	Incr Qty-Appurt 4" Type 1	1	EA	88.00	0	0	0	0.00	0.00
.	Incr Qty-Appurt 4" Type 2	2	EA	86.00	0	0	0	0.00	0.00
.	Incr Qty-Cushion Fabric	1400	SY	2.85	0	0	0	0.00	0.00
1	LIMESTONE AGGREGATE							
	Add-Limestone Aggregate							
	Mix with Peat @0.055 Limestone							
	to 1 CY Peat	264	CY	20.00	0	0	0	0.00	0.00
EE	INTERCEPTOR DRAIN SYSTEM							
.	Incr Qty-Geocomposite	12200	SF	1.25	0	9,059	9,059	11,323.75	11,323.75
	Incr Qty-Drain Pipe, 4"	400	LF	8.00	0	0	0	0.00	0.00
	Incr Qty-Perf Pipe, 4"	400	LF	9.00	0	0	0	0.00	0.00
	Incr Qty-Pipe Cleanouts	10	EA	75.00	0	0	0	0.00	0.00
								11,323.75	11,323.75

CASCADE MINE DRAINAGE
DSL-AMRR NO. 91-001
PAY REQUEST NO. THREE

Item No.	Description	Contr Qty		Contr Unit Price	Prev Qty Req'd	Curr Qty Compl	Total Qty Compl To Date	Total Contract Amount Compl To Date	Amount Due This Payment
1	Mobilization. Bonding and Insurance		LS	10.000.00	9.600.00	0.00%	96.00%	9.600.00	0.00
2	Site Access		LS	12.880.00	10.175.20	0.00%	79.00%	10.175.20	0.00
3	Site Dewatering		LS	9.844.00	4.429.80	~~0.00%~~ 15.00	60.00%	5.906.40	1.476.60
4	Site Earthwork	49029.0	LS	31,400.00	9.507.00	~~49.72%~~ 40.02	70.30%	22.074.20	12.567.20
5	Fine Grading	3584.9	LS	2.240.00	0.00	50.00%	50.00%	1.120.00	1.120.00
6	Bentonite Seal	71400	SF	0.39	0	970	970	378.30	378.30
7	Membrane Liner	57100	SF	0.49	0	0	0	0.00	0.00
8	Membrane Liner	19580	SF	1.40	0	0	0	0.00	0.00
9	Filter Gravel	1475	CY	20.00	0	0	0	0.00	0.00
10	Peat	1407	CY	35.00	0	0	0	0.00	0.00
11	Peat-DCW	1065	CY	35.00	0	0	0	0.00	0.00
12	Hay Bale Dikes	300	EA	5.00	0	0	0	0.00	0.00
13	Lime Application	5	AC	1.800.00	0	0	0	0.00	0.00
14	Stock Tank. 1000 gal	1	EA	2.500.00	0	0	0	0.00	0.00
15	Weir Outlet Structure	3	EA	800.00	0	0	0	0.00	0.00
16	Geocomposite	11000	SF	1.25	11.000	0	11.000	13.750.00	0.00
17	Drain Pipe. 4"	3650	LF	8.00	1.805	0	1.805	14.440.00	0.00
18	Perforated Pipe. 4"	2860	LF	9.00	2.806	0	2.806	25.254.00	0.00
19	18" PE Culvert	20	LF	40.00	0	0	0	0.00	0.00
20	Drain Pipe Concrete	34	EA	100.00	0	0	0	0.00	0.00
21	Pipe Cleanout Assmbly	64	EA	75.00	53	0	53	3.975.00	0.00
22	Appurt.. 4" Type 1	28	EA	88.00	13	0	13	1.144.00	0.00
23	Appurt.. 4" Type 2	102	EA	86.00	58	0	58	4.988.00	0.00
24	PVC Valves. 4"	10	EA	280.00	3	0	3	840.00	0.00
25	Service Hole. 72"	4	EA	2.790.00	2	1	3	8.370.00	2.790.00
26	Limestone Aggregate	270	EA	15.00	0	0	0	0.00	0.00
27	Cushion Fabric	6820	SY	2.85	0	0	0	0.00	0.00
28	Riprap	52	CY	40.00	0	0	0	0.00	0.00
29	Close Mine Opening-Adit	2	EA	750.00	0	0	0	0.00	0.00
30	Import Cover Soil	2800	CY	6.50	0	0	0	0.00	0.00
31	Fertilize and Seed	8	AC	950.00	0	0	0	0.00	0.00
32	Mulch	8	AC	650.00	0	0	0	0.00	0.00
33	Remove & Salvage Fence	5100	LF	0.35	2.259	0	2.259	790.65	0.00
34	Farm Fence(Type F-4M)	6420	LF	2.30	0	0	0	0.00	0.00
35	Farm Fence Gate. 16'	15	EA	70.00	0	0	0	0.00	0.00
36	Farm Fence(Type F-5M)	4295	LF	2.40	0	0	0	0.00	0.00
37	Erosion Contr.Mat.Vinyl	200	SY	7.50	0	0	0	0.00	0.00
38	Erosion Control Mat Biodegradable	2300	SY	5.25	0	0	0	0.00	0.00
1	CO#1-see attached				11.323.75	15.593.92	-	26.917.67	15.593.92
	SUBTOTAL							149.723.42	33.926.02
	Material on Site (See attached schedule)	---		---	28.862.00	0.00	---	40.798.00	11.936.00
								190.521.42	45.862.02

ABM
11/27/91

CASCADE MINE DRAINAGE
DSL-AMRB NO. 91-001 CHANGE ORDER #1
PAY REQUEST NO. THREE

tem o.	Description	Contr Qty	Contr Unit Price	Prev Qty Req'd	Curr Qty Compl	Total Qty Compl To Date	Total Contract Amount Compl To Date	Amount Due This Payment
E	INCREASE WETLAND SIZE							
.	Incr Qty-Site Earthwork							
	2350 CY @ $7.50/CY	LS	17,625.00	0.00%	80.00%	80.00%	14,100.00	14,100.00
.	Incr Qty-Fine Grading							
	0.7 AC @ $1,867.00/AC	LS	1,306.90	0.00%	75.00%	75.00%	980.18	980.18
.	Incr Qty-Bentonite Seal	12500 SF	0.39	0	0	0	0.00	0.00
.	Incr Qty-Membrane Liner	12500 SF	0.49	0	0	0	0.00	0.00
.	Incr Qty-Filter Gravel	1320 CY	20.00	0	0	0	0.00	0.00
.	Add Peat-OM (new item)	2375 CY	20.00	0	0	0	0.00	0.00
.	Incr Qty-Hay Bale Dikes	300 EA	5.00	0	0	0	0.00	0.00
.	Incr Qty-Weir Outlet Str.	1 EA	800.00	0	0	0	0.00	0.00
.	Incr Qty-Drain Pipe, 4"	30 LF	8.00	0	0	0	0.00	0.00
.	Incr Qty-Perf Pipe, 4"	50 LF	9.00	0	0	0	0.00	0.00
.	Incr Qty-Appurt 4" Type 1	1 EA	88.00	0	0	0	0.00	0.00
.	Incr Qty-Appurt 4" Type 2	2 EA	86.00	0	0	0	0.00	0.00
.	Incr Qty-Cushion Fabric	1400 SY	2.85	0	0	0	0.00	0.00
D	LIMESTONE AGGREGATE							
	Add-Limestone Aggregate							
	Mix with Peat @0.055 Limestone							
	to 1 CY Peat	264 CY	20.00	0	0	0	0.00	0.00
EE	INTERCEPTOR DRAIN SYSTEM							
	Incr Qty-Geocomposite	12200 SF	1.25	9,059	411	9,470	11,837.50	513.75
.	Incr Qty-Drain Pipe, 4"	400 LF	8.00	0	0	0	0.00	0.00
	Incr Qty-Perf Pipe, 4"	400 LF	9.00	0	0	0	0.00	0.00
.	Incr Qty-Pipe Cleanouts	10 EA	75.00	0	0	0	0.00	0.00
							26,917.67	15,593.92

SCHEDULE OF MATERIAL ON SITE

PROJECT TITLE: CASCADE MINE DRAINAGE
MONT A/E or DSL-AMRB: 91-001
CONTRACTOR: SHARBONO CONSTRUCTION, INC.

				Bentonite Seal	Wyo-Ben, Inc.
ITEM 6	Material Delivered	14,784.00			
	Material in Place	0.00			
	Material on Site		14,784.00		
ITEM 9	Material Delivered	0.00		Filter Gravel	Dickman Excavation
	Material in Place	0.00			
	Material on Site		0.00		
ITEM 13	Material Delivered	1,512.00		Lime Application	Montana Limestone
	Material in Place	0.00			
	Material on Site		1,512.00		
ITEM 14	Material Delivered	555.00		Stock Tank	Kustom City Fiberglass
	Material in Place	0.00			
	Material on Site		555.00		
ITEM 15	Material Delivered	2,000.00		Weir Outlet Str.	Elk River Concrete
	Material in Place	0.00			
	Material on Site		2,000.00		
ITEM 17	Material Delivered	6,456.00		4" Drain Pipe	Dana Kepner
	Material in Place	3,192.00			
	Material on Site		3,264.00		
ITEM 19	Material Delivered	240.00		18" PE Culvert	Dana Kepner
	Material in Place	0.00			
	Material on Site		240.00		
ITEM 22	Material Delivered	2,133.00		Type 1 Appur	Dana Kepner
	Material in Place	990.00			
	Material on Site		1,143.00		
ITEM 23	Material Delivered	4,714.00		Type 2 Appur	Dana Kepner
	Material in Place	2,455.00			
	Material on Site		2,259.00		
ITEM 24	Material Delivered	1,717.00		4" PVC Valves	Dana Kepner
	Material in Place	515.00			
	Material on Site		1,202.00		
ITEM 25	Material Delivered	7,700.00		72" Service Hole	Elk River Concrete
	Material in Place	5,775.00			
	Material on Site		1,925.00		
ITEM 26	Material Delivered	6,984.00		Limestone Aggregate	Nature's Calcium
	Material in Place	0.00			
	Material on Site		6,984.00		
ITEM 30	Material Delivered	0.00		Import Cover Soil	
	Material in Place	0.00			
	Material on Site		0.00		
	PAGE SUBTOTAL		$35,868.00		

SCHEDULE OF MATERIAL ON SITE PAGE 2

PROJECT TITLE: CASCADE MINE DRAINAGE
MONT A/E or DSL-AMRB: 91-001
CONTRACTOR: SHARBONO CONSTRUCTION, INC.

ITEM 31	Material Delivered	1,485.00		Fertilize & Seed	Agri Feeds
	Material in Place	0.00			
	Material on Site		1,485.00		
ITEM 34	Material Delivered	1.653.00		Farm Fence	Carl Weissman
	Material in Place	0.00		(Type F-4M)	Marks Miller
	Material on Site		1.653.00		
ITEM 35	Material Delivered	609.00		Farm Fence	Carl Weissman
	Material in Place	0.00		(16' Gate)	Marks Miller
	Material on Site		609.00		
ITEM 36	Material Delivered	1.183.00		Farm Fence	Carl Weissman
	Material in Place	0.00		(Type F-5M)	Marks Miller
	Material on Site		1.183.00		
			4,930.00		
	PAGE 1 SUBTOTAL		35.868.00		
			40,798.00		

Requested by: SHARBONO CONSTRUCTION, INC.

TO BE INCLUDED WITH PAY REQUEST NO. THREE

CASCADE MINE DRAINAGE
DSL-AMRB NO. 91-001 CHANGE ORDER #1
PAY REQUEST NO. TWO

Item No.	Description	Contr Qty	Contr Unit Price	Prev Qty Req'd	Curr Qty Compl	Total Qty Compl To Date	Total Contract Amount Compl To Date	Amount Due This Payment
NE	INCREASE WETLAND SIZE							
a.	Incr Qty-Site Earthwork							
	2350 CY @ $7.50/CY	LS	17,625.00	0.00	00.0%	00.0%	0.00	0.00
b.	Incr Qty-Fine Grading							
	0.7 AC @ $1,867.00/AC	LS	1,306.90	0.00	00.0%	00.0%	0.00	0.00
c.	Incr Qty-Bentonite Seal	12500 SF	0.39	0	0	0	0.00	0.00
d.	Incr Qty-Membrane Liner	12500 SF	0.49	0	0	0	0.00	0.00
e.	Incr Qty-Filter Gravel	1320 CY	20.00	0	0	0	0.00	0.00
f.	Add Peat-OM (new item)	2375 CY	20.00	0	0	0	0.00	0.00
g.	Incr Qty-Hay Bale Dikes	300 EA	5.00	0	0	0	0.00	0.00
h.	Incr Qty-Weir Outlet Str.	1 EA	800.00	0	0	0	0.00	0.00
i.	Incr Qty-Drain Pipe, 4"	30 LF	8.00	0	0	0	0.00	0.00
j.	Incr Qty-Perf Pipe, 4"	50 LF	9.00	0	0	0	0.00	0.00
k.	Incr Qty-Appurt 4" Type 1	1 EA	88.00	0	0	0	0.00	0.00
l.	Incr Qty-Appurt 4" Type 2	2 EA	86.00	0	0	0	0.00	0.00
m.	Incr Qty-Cushion Fabric	1400 SY	2.85	0	0	0	0.00	0.00
0	LIMESTONE AGGREGATE							
.	Add-Limestone Aggregate							
	Mix with Peat @0.055 Limestone							
	to 1 CY Peat	264 CY	20.00	0	0	0	0.00	0.00
REE	INTERCEPTOR DRAIN SYSTEM							
a.	Incr Qty-Geocomposite	12200 SF	1.25	0	9,059	9,059	11,323.75	11,323.75
b.	Incr Qty-Drain Pipe, 4"	400 LF	8.00	0	0	0	0.00	0.00
c.	Incr Qty-Perf Pipe, 4"	400 LF	9.00	0	0	0	0.00	0.00
d.	Incr Qty-Pipe Cleanouts	10 EA	75.00	0	0	0	0.00	0.00
							11,323.75	11,323.75

SCHEDULE OF MATERIAL ON SITE

PROJECT TITLE: CASCADE MINE DRAINAGE
MONT A/E or DSL-AMRB: 91-001
CONTRACTOR: SHARBONO CONSTRUCTION, INC.

ITEM 6	Material Delivered	7,392.00	
	Material in Place	0.00	
	Material on Site		7,392.00
ITEM 17	Material Delivered	4,584.00	
	Material in Place	2,267.00	
	Material on Site		2,317.00
ITEM 18	Material Delivered	1,575.00	
	Material in Place	1,545.00	
	Material on Site		30.00
ITEM 19	Material Delivered	240.00	
	Material in Place	0.00	
	Material on Site		240.00
ITEM 22	Material Delivered	2,133.00	
	Material in Place	990.00	
	Material on Site		1,143.00
ITEM 23	Material Delivered	4,714.00	
	Material in Place	2,455.00	
	Material on Site		2,259.00
ITEM 24	Material Delivered	1,717.00	
	Material in Place	515.00	
	Material on Site		1,202.00
ITEM 25	Material Delivered	7,700.00	
	Material in Place	3,850.00	
	Material on Site		3,850.00
ITEM 26	Material Delivered	6,984.00	
	Material in Place	0.00	
	Material on Site		6,984.00
ITEM 34	Material Delivered	1,653.00	
	Material in Place	0.00	
	Material on Site		1,653.00
ITEM 35	Material Delivered	609.00	
	Material in Place	0.00	
	Material on Site		609.00
ITEM 36	Material Delivered	1,183.00	
	Material in Place	0.00	
	Material on Site		1,183.00
	TOTAL MATERIAL ON SITE		$28,862.00
	(Invoices provided)		

Requested by: SHARBONO CONSTRUCTION, INC.

TO BE INCLUDED WITH PAY REQUEST NO. TWO

RECEIVED
DEC 17 1991
STATE LANDS

PAYMENT REQUEST NO. FOUR

FROM 11/1/91 TO 11/30/91

PROJECT TITLE: CASCADE MINE DRAINAGE

LOCATION: CENTERVILLE "C"/STOCKETT MONT A/E or DSL-AMRB: 91-001

NAME OF CONTRACTOR: SHARBONO CONSTRUCTION, INC.

ADDRESS: 1826 NORTH MAIN, HELENA, MT 59601

SUMMARY OF PROJECT STATUS

Amount of Original Contract		$ 483,458.00
Change Order No. 1	$ 139,151.90	
Change Order No. ____	$	
Change Order No. ____	$	
Amount of Approved Change Order(s)		$ 139,151.90
TOTAL CONTRACT AMOUNT		$ 622,609.90

Pay Request No.	Amount of Request
ONE	62,065.71
TWO	68,127.75
THREE	41,275.82
FOUR	91,780.94

RBM 12/16/91

Total Contract Amount Completed to Date	$ 292,500.24
Less Retainage (10%)	$ 29,250.02
TOTAL AMOUNT EARNED TO DATE	$ 263,250.22
Less Previous Payments	$ 171,469.28
AMOUNT DUE THIS PAYMENT	$ 91,780.94
Less 1% Tax	$ 917.81
TOTAL DUE CONTRACTOR	$ 90,863.13

I certify that this claim is correct and just in all respects and that payment or credit has not been received.

SHARBONO CONSTRUCTION, INC.
Contractor

By Wilbert Sharbono

Date DECEMBER 12, 1991

RECOMMENDED BY:

ROBERT PELLA & ASSOC.
Engineer

By Robert B Morton

Date 12/16/91

APPROVED BY:

Dept. of State Lands, Abandoned Mine Reclamation Bureau
Owner

By Edward C. Lewis

Date Dec 19, 1991

CASCADE MINE DRAINAGE
DSL-AMRB NO. 91-001
PAY REQUEST NO. THREE

Item No.		Description	Contr Qty		Contr Unit Price	Prev Qty/Amt Req'd	Curr Qty/% Compl	Total Qty/% Compl To Date	Total Contract Amount Compl To Date	Amount Due This Payment
1		Mobilization, Bonding and Insurance	LS		10,000.00	9,600.00	0.00%	96.00%	9,600.00	0.00
2		Site Access	LS		12,880.00	10,175.20	0.00%	79.00%	10,175.20	0.00
3		Site Dewatering	LS		9,844.00	5,906.40	0.00%	60.00%	5,906.40	0.00
4	*	Site Earthwork	LS		49,025.00	36,174.20	6.22%	80.00%	39,220.00	3,045.80
5	*	Fine Grading	LS		3,546.90	2,100.18	15.79%	75.00%	2,660.18	560.00
6	*	Bentonite Seal	83900	SF	0.39	970	41,072.48	42,042.48	16,396.57	16,018.27
7	*	Membrane Liner-PVC	69600	SF	0.49	0	0	0	0.00	0.00
8		Membrane Liner-Hypalon	19580	SF	1.40	0	0	0	0.00	0.00
9	*	Filter Gravel	2795	CY	20.00	0	0	0	0.00	0.00
10		Peat	1407	CY	35.00	0	0	0	0.00	0.00
11		Peat-DCW	1065	CY	35.00	0	0	0	0.00	0.00
12	*	Hay Bale Dikes	600	EA	5.00	0	0	0	0.00	0.00
13		Lime Application	5	AC	1,800.00	0	5.1	5.1	9,180.00	9,180.00
14		Stock Tank, 1000 gal	1	EA	2,500.00	0	0	0	0.00	0.00
15	*	Weir Outlet Structure	4	EA	800.00	0	3	3	2,400.00	2,400.00
16	*	Geocomposite	23200	SF	1.25	20,470	371	20,841	26,051.25	463.75
17	*	Drain Pipe, 4"	4080	LF	8.00	1,805	960	2,765	22,120.00	7,680.00
18	*	Perforated Pipe, 4"	3310	LF	9.00	2,806	84	2,890	26,010.00	756.00
19		18" PE Culvert	20	LF	40.00	0	0	0	0.00	0.00
20		Drain Pipe Concrete	34	EA	100.00	0	0	0	0.00	0.00
21	*	Pipe Cleanout Assmbly.	74	EA	75.00	53	6	59	4,425.00	450.00
22	*	Appurt., 4" Type 1	23	EA	88.00	13	11	24	2,112.00	968.00
23	*	Appurt., 4" Type 2	104	EA	86.00	58	17	75	6,450.00	1,462.00
24		PVC Valves, 4".	10	EA	280.00	3	2	5	1,400.00	560.00
25		Service Hole, 72"	4	EA	2,790.00	3	0	3	8,370.00	0.00
26		Limestone Aggregate	270	EA	15.00	0	0	0	0.00	0.00
27	*	Cushion Fabric	8220	SY	2.85	0	0	0	0.00	0.00
28		Riprap	52	CY	40.00	0	0	0	0.00	0.00
29		Close Mine Opening-Adit	2	EA	750.00	0	2	2	1,500.00	1,500.00
30		Import Cover Soil	2800	CY	6.50	0	1,850	1,850	12,025.00	12,025.00
31		Fertilize and Seed	8	AC	950.00	0	0	0	0.00	0.00
32		Mulch	8	AC	650.00	0	0	0	0.00	0.00
33		Remove & Salvage Fence	5100	LF	0.35	2,259	0	2,259	790.65	0.00
34		Farm Fence(Type F-4M)	6420	LF	2.30	0	0	0	0.00	0.00
35		Farm Fence Gate, 16'	15	EA	70.00	0	1	1	70.00	70.00
36		Farm Fence(Type F-5M)	4295	LF	2.40	0	0	0	0.00	0.00
37		Erosion Contr.Mat,Vinyl	200	SY	7.50	0	0	0	0.00	0.00
38		Erosion Contr.Mat,Biodegr	2300	SY	5.25	0	0	0	0.00	0.00
39	**	Peat-OM	2375	CY	20.00	0	0	0	0.00	0.00
40	**	Limestone Aggr Mix W/Peat	264	CY	20.00	0	0	0	0.00	0.00
		SUBTOTAL							206,862.24	57,138.81
		Material on Site (See attached schedule)	---		---	40,798.00	---	---	85,638.00	44,840.00
									292,500.24	101,978.81

* Qty/Price adjusted by Change Order #1
** New Item from change Order #1

ABM
12/16/91

SCHEDULE OF MATERIAL ON SITE

PROJECT TITLE: CASCADE MINE DRAINAGE
MONT A/E or DSL-AMRB: 91-001
CONTRACTOR: SHARBONO CONSTRUCTION, INC.

RE: PAY REQUEST #4

					Bentonite Seal	Wyo-Ben, Inc.
ITEM 6	Material Delivered	14,784.00				
	Material in Place	7,392.00				
	Material on Site		7,392.00			
ITEM 9	Material Delivered	27,319.00			Filter Gravel	Dickman Excavation
	Material in Place	0.00				
	Material on Site		27,319.00			
					PBAT	HERITAGE SUPPLY
ITEM 10	Material Delivered	29,588.00			~~Lime Application~~	~~Montana Limestone~~
	Material in Place	0.00				
	Material on Site		29,588.00			
ITEM 14	Material Delivered	555.00			Stock Tank	Kustom City Fiberlass
	Material in Place	0.00				
	Material on Site		555.00			
ITEM 15	Material Delivered	2,000.00			Weir Outlet Str.	Elk River Concrete
	Material in Place	1,500.00				
	Material on Site		500.00			
ITEM 17	Material Delivered	6,456.00			4" Drain Pipe	Dana Kepner
	Material in Place	4,375.00				
	Material on Site		2,081.00			
ITEM 18	Material Delivered	1,575.00			4" Perforated Pipe	Dana Kepner
	Material in Place	1,300.00				
	Material on Site		275.00			
ITEM 19	Material Delivered	240.00			18" PE Culvert	Dana Kepner
	Material in Place	0.00				
	Material on Site		240.00			
ITEM 22	Material Delivered	2,133.00			Type 1 Appur	Dana Kepner
	Material in Place	1,765.00				
	Material on Site		368.00			
ITEM 23	Material Delivered	4,809.00			Type 2 Appur	Dana Kepner
	Material in Place	3,468.00				
	Material on Site		1,341.00			
ITEM 24	Material Delivered	1,717.00			4" PVC Valves	Dana Kepner
	Material in Place	859.00				
	Material on Site		858.00			
ITEM 25	Material Delivered	7,700.00			72" Service Hole	Elk River Concrete
	Material in Place	5,775.00				
	Material on Site		1,925.00			
ITEM 26	Material Delivered	6,984.00			Limestone Aggregate	Nature's Calcium
	Material in Place	0.00				
	Material on Site		6,984.00			
	PAGE SUBTOTAL		$79,426.00			

ABM
12/16/91

SCHEDULE OF MATERIAL ON SITE PAGE 2

PROJECT TITLE: CASCADE MINE DRAINAGE
MONT A/E or DSL-AMRB: 91-001
CONTRACTOR: SHARBONO CONSTRUCTION, INC.

ITEM 30	Material Delivered	4,000.00		Cover Soil	Kenneth Engelhe
	Material in Place	3,700.00			
	Material on Site		300.00		
ITEM 31	Material Delivered	1,485.00		Fertilize & Seed	Agri Feeds
	Material in Place	0.00			
	Material on Site		1,485.00		
ITEM 34	Material Delivered	1,653.00		Farm Fence	Carl Weissman
	Material in Place	0.00		(Type F-4M)	Marks Miller
	Material on Site		1,653.00		
ITEM 35	Material Delivered	609.00		Farm Fence	Carl Weissman
	Material in Place	41.00		(16' Gate)	Marks Miller
	Material on Site		568.00		
ITEM 36	Material Delivered	1,183.00		Farm Fence	Carl Weissman
	Material in Place	0.00		(Type F-5M)	Marks Miller
	Material on Site		1,183.00		
ITEM 38	Material Delivered	1,023.00		Erosion Contr Mat	Roscoe Steel
	Material in Place	0.00			
	Material on Site		1,023.00		
			6,212.00		
	PAGE 1 SUBTOTAL		79,426.00		
			85,638.00		

Requested by: SHARBONO CONSTRUCTION, INC.

TO BE INCLUDED WITH PAY REQUEST NO. FOUR

PAYMENT REQUEST NO. FIVE

FROM 11/30/91 TO 4/30/92

PROJECT TITLE: CASCADE MINE DRAINAGE

LOCATION: CENTERVILLE "C"/STOCKETT MONT A/E or DSL-AMRB: 91-001

NAME OF CONTRACTOR: SHARBONO CONSTRUCTION, INC.

ADDRESS: 1826 NORTH MAIN, HELENA, MT 59601

SUMMARY OF PROJECT STATUS

Amount of Original Contract		$ 483,458.00
Change Order No. 1	$ 139,151.90	
Change Order No. ____	$	
Change Order No. ____	$	
Amount of Approved Change Order(s)		$ 139,151.90
TOTAL CONTRACT AMOUNT		$ 622,609.90

Pay Request No.	Amount of Request
ONE	62,065.71
TWO	68,127.75
THREE	41,275.82
FOUR	91,780.94
FIVE	132,364.87

RBM 5/18/92

Total Contract Amount Completed to Date	$ ~~497,357.32~~	439,572.32
Less Retainage (10%)	$ ~~49,735.73~~	43,957.23
TOTAL AMOUNT EARNED TO DATE	$ ~~447,621.59~~	395615.09
Less Previous Payments	$ 263,250.22	
AMOUNT DUE THIS PAYMENT	$ ~~184,371.37~~	132364.87
Less 1% Tax	$ ~~1,843.71~~	1323.65
TOTAL DUE CONTRACTOR	$ ~~182,527.66~~	131041.22

I certify that this claim is correct and just in all respects and that payment or credit has not been received.

SHARBONO CONSTRUCTION, INC.
Contractor

By Prudence K Wiz

Date 5-8-92

RECOMMENDED BY:

ROBERT FRICCH & ASSOC
Engineer

By Robt B Morton

Date 5/18/92

APPROVED BY:

Dept. of State Lands, Abandoned Mine Reclamation Bureau
Owner

By 5/19/92 Bonnie Lovelace

Date 5/19/92

9 20044-01

Processed 5/19/92

[illegible] MINE [illegible]
DSL-AMRR NO. 81-011
P&W PROJECT NO. P102

No.		Description	Contr Qty	Contr Unit Price	Prev Amount Req'd	This Period Compl	Total Qty Compl To Date	Total Contract Amount Compl To Date	Amount Due This Payment
1		Mobilization, Bonding and Insurance	LS	10,000.00	9,600.00	0.00%	100.00%	10,000.00	400.00
2		Site Access	LS	12,880.00	10,175.20	0.00%	79.00%	10,175.20	0.00
3		Site Dewatering	LS	9,844.00	5,906.40	0.00%	75.00%	7,383.00	1,476.60
4	*	Site Earthwork	LS	49,025.00	39,220.00	6.22%	90.00%	44,122.50	4,902.50
5	*	Fine Grading	LS	3,546.90	2,660.18	15.79%	100.00%	3,546.90	886.72
6	*	Bentonite Seal	83900 SF	0.39	42,042.48	28,725.52	70,768	27,599.52	11,202.95
7	*	Membrane Liner-PVC	69600 SF	0.49	0	63,005	63,005	30,872.45	30,872.45
8		Membrane Liner-Hypalon	19580 SF	1.40	0	17,530	17,530	24,542.00	24,542.00
9	*	Filter Gravel	2795 CY	20.00	0	1,733	1,733	34,660.00	34,660.00
10		Peat	1407 CY	35.00	0	760	760	26,600.00	26,600.00
11		Peat-DCW	1065 CY	35.00	0	408	408	14,280.00	14,280.00
12	*	Hay Bale Dikes	600 EA	5.00	0	206	206	1,030.00	1,030.00
13		Lime Application	5 AC	1,800.00	5.1	~~0.17~~ 0.7	5.1758	~~10,146.00~~	~~126.00~~ 1260.00
14		Stock Tank, 1000 gal	1 EA	2,500.00	0	0	0	0.00	0.00
15	*	Weir Outlet Structure	4 EA	800.00	3	1	4	3,200.00	800.00
16	*	Geocomposite	23200 SF	1.25	20,841	364	21,205	26,506.25	455.00
17	*	Drain Pipe, 4"	4080 LF	8.00	2,765	1,316	4,081	32,648.00	10,528.00
18	*	Perforated Pipe, 4"	3310 LF	9.00	2,890	301	3,191	28,719.00	2,709.00
19		18" PE Culvert	20 LF	40.00	0	20	20	800.00	800.00
20		Drain Pipe Concrete	34 EA	100.00	0	0	0	0.00	0.00
21	*	Pipe Cleanout Assmblv	74 EA	75.00	59	6	65	4,875.00	450.00
22	*	Appurt., 4" Type 1	29 EA	88.00	24	7	(31)	2,728.00	616.00
23	*	Appurt., 4" Type 2	104 EA	86.00	75	72	147	12,642.00	6,192.00
24		PVC Valves, 4"	10 EA	280.00	5	4	9	2,520.00	1,120.00
25		Service Hole, 72"	4 EA	2,790.00	3	1	4	11,160.00	2,790.00
26		Limestone Aggregate	270 CY	15.00	0	270	270	4,050.00	4,050.00
27	*	Cushion Fabric	8220 SY	2.85	0	7,545	7,545	21,503.25	21,503.25
28		Riprap	52 CY	40.00	0	26	26	1,040.00	1,040.00
29		Close Mine Opening-Adit	2 EA	750.00	2	0	2	1,500.00	0.00
30		Import Cover Soil	2800 CY	6.50	1,850	0	1,850	12,025.00	0.00
31		Fertilize and Seed	8 AC	950.00	0	0	0	0.00	0.00
32		Mulch	8 AC	650.00	0	0	0	0.00	0.00
33		Remove & Salvage Fence	5100 LF	0.35	2,259	488	2,747	961.45	170.80
34		Farm Fence(Type F-4M)	6420 LF	2.30	0	3,636	3,636	8,362.80	8,362.80
35		Farm Fence Gate, 16'	15 EA	70.00	1	4	5	350.00	280.00
36		Farm Fence(Type F-5M)	4295 LF	2.40	0	0	0	0.00	0.00
37		Erosion Contr.Mat.Vinyl	200 SY	7.50	0	0	0	0.00	0.00
38		Erosion Contr.Mat.Biodegr	2300 SY	5.25	0	0	0	0.00	0.00
39	**	Peat-OM	2375 CY	20.00	0	0	0	0.00	0.00
40	**	Limestone Aggr Mix W/Peat	264 CY	20.00	0	66	66	1,320.00	1,320.00
		SUBTOTAL						~~432,162.32~~ ~~421,928.32~~	~~215,300.07~~ ~~211,166.07~~
		Material on Site (See attached schedule)	---	---	85,638.00	---	---	~~76,320.00~~ 17,410.00	~~(8,338.00)~~ (68,228.00)
								~~497,357.32~~ 459,572.32	~~284,857.07~~ 147,072.07

* Qty/Price adjusted by Change Order #1
** New Item from change Order #1

JNR 5/19/92

ABM 5/18/92

SCHEDULE OF MATERIAL ON SITE

PROJECT TITLE: CASCADE MINE DRAINAGE RE: PAY REQUEST #5
MONT A/E or DSL-AMRB: 91-001
CONTRACTOR: SHARBONO CONSTRUCTION, INC.

ITEM 6	Material Delivered	14,784.00		Bentonite Seal	Wyo-Ben, Inc.
	Material in Place	12,470.00			
	Material on Site		~~2,314.00~~	ϕ	
ITEM 7	Material Delivered	23,686.00		PVC Liner	Environmental Liners
	Material in Place	21,075.00			
	Material on Site		~~2,611.00~~	ϕ	
ITEM 8	Material Delivered	27,572.00		Hypalon Liner	Environmental Liners
	Material in Place	17,355.00			
	Material on Site		~~10,217.00~~	ϕ	
ITEM 9	Material Delivered	32,469.00		Filter Gravel	Dickman Excavation
	Material in Place	21,404.00			
	Material on Site		~~11,065.00~~	120.00 (6 cy)	
ITEM 10	Material Delivered	35,490.00		Peat	Heritage Supply
	Material in Place	19,170.00			
	Material on Site		~~16,320.00~~	2660.00 (76 cy)	
ITEM 11	Material Delivered	35,986.00		Peat - DCW	Heritage Supply
	Material in Place	13,786.00			
	Material on Site		~~22,200.00~~	3955.00 (113 cy)	
ITEM 14	Material Delivered	555.00		Stock Tank	Kustom City Fiberlass
	Material in Place	0.00			
	Material on Site		555.00		
ITEM 24	Material Delivered	1,717.00		4" PVC Valves	Dana Kepner
	Material in Place	1,545.00			
	Material on Site		172.00		
ITEM 27	Material Delivered	5,733.00		Cushion Fabric	Environmental Liners
	Material in Place	4,806.00			
	Material on Site		~~927.00~~	ϕ	
ITEM 31	Material Delivered	1,485.00		Fertilize & Seed	Agri Feeds
	Material in Place	0.00			
	Material on Site		1,485.00		
ITEM 38	Material Delivered	8,463.00		Erosion Contr Mat	Roscoe Steel
	Material in Place	0.00			
	Material on Site		8,463.00		
			~~76,329.00~~	17,410.00	

ABM
5/18/92

Requested by: SHARBONO CONSTRUCTION, INC.

TO BE INCLUDED WITH PAY REQUEST NO. FIVE

PAYMENT REQUEST NO. SIX

RECEIVED
OCT 9 - 1992
ROBERT PECCIA & ASSOCIATES

FROM 5/1/92 TO 8/31/92

PROJECT TITLE: CASCADE MINE DRAINAGE

LOCATION: CENTERVILLE "C"/STOCKETT MONT A/E or DSL-AMRB: 91-004

NAME OF CONTRACTOR: SHARBONO CONSTRUCTION, INC.

ADDRESS: 1826 NORTH MAIN, HELENA, MT 59601

SUMMARY OF PROJECT STATUS

Amount of Original Contract		$ 483,458.00
Change Order No. 1	$ 139,151.90	
Change Order No. ____	$	
Change Order No. ____	$	
Amount of Approved Change Order(s)		$ 139,151.90
TOTAL CONTRACT AMOUNT		$ 622,609.90

Pay Request No.	Amount of Request
ONE	62,065.71
TWO	68,127.75
THREE	41,275.82
FOUR	91,780.94
FIVE	132,364.87
SIX	200,097.92

ABM
9/25/92

Total Contract Amount Completed to Date	$ ~~712,678.51~~	595,713.01
Less Retainage (~~XXX~~%)	$ -0-	
TOTAL AMOUNT EARNED TO DATE	$ ~~712,678.51~~	595,713.01
Less Previous Payments ~~OF $395,615.09 LESS DISPUTED AMT$98,884.50~~	$ ~~494,499.59~~	395,615.09
AMOUNT DUE THIS PAYMENT	$ ~~218,178.92~~	200,097.92
Less 1% Tax	$ ~~2,181.79~~	2,000.98
TOTAL DUE CONTRACTOR	$ ~~215,997.13~~	198,096.94

I certify that this claim is correct and just in all respects and that payment or credit has not been received.

SHARBONO CONSTRUCTION, INC.
Contractor

By Robert Sharbono

Date 9/22/92 (SEE NOTE BELOW)

RECOMMENDED BY:

ROBERT PECCIA & ASSOC
Engineer

By Robert D Motor

Date 9/25/92

APPROVED BY:

Dept. of State Lands, Abandoned Mine Reclamation Bureau
Owner

By John Koetter Program Supervision DSL-AMRB

Date 9/30/92

NOTE: THIS BILLING REPRESENTS ENGINEER'S APPROVED QUANTITIES OF BID ITEMS. IT IS NOT A FINAL BILLING AS SHARBONO CONSTRUCTION, INC. DISPUTES QUANTITIES APPROVED ON SEVERAL ITEMS AS LOWER THAN ACTUAL QUANTITIES INSTALLED.

Rev. 3/91

CASCADE MINE DRAINAGE
DSL-AMRB NO. 91-001
PAY REQUEST NO. SIX

Item No.		Description	Contr Qty	Contr Unit Price	Prev Qty/Amt Req'd	Curr Qty/% Compl	Total Qty/% Compl To Date	Total Contract Amount Compl To Date	Amount Due This Payment
1		Mobilization, Bonding and Insurance	LS	10,000.00	10,000.00	0.00%	100.00%	10,000.00	0.00
2		Site Access	LS	12,880.00	10,175.20	21.00%	100.00%	12,880.00	2,704.80
3		Site Dewatering	LS	9,844.00	7,383.00	25.00%	100.00%	9,844.00	2,461.00
4	*	Site Earthwork	LS	49,025.00	44,122.50	10.00%	100.00%	49,025.00	4,902.50
5	*	Fine Grading	LS	3,546.90	3,546.90	0.00%	100.00%	3,546.90	0.00
6	*	Bentonite Seal	83900 SF	0.39	70,768	676.0	71,444.0	27,863.16	263.64
7	*	Membrane Liner-PVC	69600 SF	0.49	63,005	0.0	63,005.0	30,872.45	0.00
8		Membrane Liner-Hypalon	19580 SF	1.40	17,530	0.0	17,530.0	24,542.00	0.00
9	*	Filter Gravel	2795 CY	20.00	1,733	8.0	1,741.0	34,820.00	160.00
10		Peat	1407 CY	35.00	760	97.9	857.9	30,026.50	3,426.50
11		Peat-DCW	1065 CY	35.00	408	~~140.4~~ ~~657.0~~	~~548.4~~ ~~1,065.0~~	~~19,194.0~~ ~~37,275.00~~	~~22,995.00~~ 4914.0
12	*	Hay Bale Dikes	600 EA	5.00	206	300.0	506.0	2,530.00	1,500.00
13		Lime Application	5 AC	1,800.00	5.8	6.8	12.6	22,680.00	12,240.00
14		Stock Tank, 1000 gal	1 EA	2,500.00	0	1.0	1.0	2,500.00	2,500.00
15	*	Weir Outlet Structure	4 EA	800.00	4	0.0	4.0	3,200.00	0.00
16	*	Geocomposite	23200 SF	1.25	21,205	1,280.0	22,485.0	28,106.25	1,600.00
17	*	Drain Pipe, 4"	4080 LF	8.00	4,081	1,445.0	5,526.0	44,208.00	11,560.00
18	*	Perforated Pipe, 4"	3310 LF	9.00	3,191	185.0	3,376.0	30,384.00	1,665.00
19		18" PE Culvert	20 LF	40.00	20	0.0	20.0	800.00	0.00
20		Drain Pipe Concrete	34 EA	100.00	0	3.0	3.0	300.00	300.00
21	*	Pipe Cleanout Assmbly	74 EA	75.00	65	23.0	88.0	6,600.00	1,725.00
22	*	Appurt., 4" Type 1	29 EA	88.00	31	22.0	53.0	4,664.00	1,936.00
23	*	Appurt., 4" Type 2	104 EA	86.00	147	17.0	164.0	14,104.00	1,462.00
24		PVC Valves, 4"	10 EA	280.00	9	1.0	10.0	2,800.00	280.00
25		Service Hole, 72"	4 EA	2,790.00	4	0.0	4.0	11,160.00	0.00
26		Limestone Aggregate	270 CY	15.00	270	0.0	270.0	4,050.00	0.00
27	*	Cushion Fabric	8220 SY	2.85	7,545	0.0	7,545.0	21,503.25	0.00
28		Riprap	52 CY	40.00	26	16.5	42.5	1,700.00	660.00
29		Close Mine Opening-Adit	2 EA	750.00	2	1.0	3.0	2,250.00	750.00
30		Import Cover Soil	2800 CY	6.50	1,850	1,230.0	3,080.0	20,020.00	7,995.00
31		Fertilize and Seed	8 AC	950.00	0	15.5	15.5	14,725.00	14,725.00
32		Mulch	8 AC	650.00	0	15.5	15.5	10,075.00	10,075.00
33		Remove & Salvage Fence	5100 LF	0.35	2,747	2,353.0	5,100.0	1,785.00	823.55
34		Farm Fence(Type F-4M)	6420 LF	2.30	3,636	3,914.0	7,550.0	17,365.00	9,002.20
35		Farm Fence Gate, 16'	15 EA	70.00	5	7.0	12.0	840.00	490.00
36		Farm Fence(Type F-5M)	4295 LF	2.40	0	4,480.0	4,480.0	10,752.00	10,752.00
37		Erosion Contr.Mat,Vinyl	200 SY	7.50	0	200.0	200.0	1,500.00	1,500.00
38		Erosion Contr.Mat.Biodegr	2300 SY	5.25	0	1,020.0	1,020.0	5,355.00	5,355.00
39	**	Peat-OM	2375 CY	20.00	0	2,193.5	2,193.5	43,870.00	43,870.00
40	**	Limestone Aggr Mix W/Peat	264 CY	20.00	66	181.0	247.0	4,940.00	3,620.00
41	D1	Clean Old Pipes	275 LF	1.70	0	275.0	275.0	467.50	467.50
42	D2	Hand Close Adit Opening	1 EA	3000.00	0	1.0	1.0	3,000.00	3,000.00
43	D3	Belt Mine Closing	1 EA	4865.00	0	1.0	1.0	4,865.00	4,865.00
		SUBTOTAL				595,713.01	~~613,794.01~~	~~191,631.69~~	173,550.6
		MATERIAL STORED ADJUSTMENT			17,410		0	(17,410.00)	
							613,794.01	174,221.69	

* Qty/Price adjusted by Change Order #1
** New Item from change Order #1

ABM
9/25/92

(A) PER ENGINEER'S APPROVED QUANTITIES

CASCADE MINE DRAINAGE
DSL-AMRB NO. 91-001
PAY REQUEST NO. SIX

Item No.		Description	Contr Qty		Contr Unit Price	Prev Qty/Amt Req'd	Curr Qty/% Compl	Total Qty/% Compl To Date	Total Contract Amount Compl To Date	Amount Due This Payment
1		Mobilization, Bonding and Insurance	LS		10,000.00	10,000.00	0.00%	100.00%	10,000.00	0.00
2		Site Access	LS		12,880.00	10,175.20	21.00%	100.00%	12,880.00	2,704.80
3		Site Dewatering	LS		9,844.00	7,383.00	25.00%	100.00%	9,844.00	2,461.00
4	*	Site Earthwork	LS		49,025.00	44,122.50	10.00%	100.00%	49,025.00	4,902.50
5	*	Fine Grading	LS		3,546.90	3,546.90	0.00%	100.00%	3,546.90	0.00
6	*	Bentonite Seal	83900	SF	0.39	70,768	676	71,444	27,863.16	263.64
7	*	Membrane Liner-PVC	69600	SF	0.49	63,005	0	63,005	30,872.45	0.00
8		Membrane Liner-Hypalon	19580	SF	1.40	17,530	0	17,530	24,542.00	0.00
9	*	Filter Gravel	2795	CY	20.00	1,733	779	2,512	50,240.00	15,580.00
10		Peat	1407	CY	35.00	760	647	1,407	49,245.00	22,645.00
11		Peat-DCW	1065	CY	35.00	408	657	1,065	37,275.00	22,995.00
12	*	Hay Bale Dikes	600	EA	5.00	206	300	506	2,530.00	1,500.00
13		Lime Application	5	AC	1,800.00	5.8	7.32	13.12	23,616.00	13,176.00
14		Stock Tank, 1000 gal	1	EA	2,500.00	0	1	1	2,500.00	2,500.00
15	*	Weir Outlet Structure	4	EA	800.00	4	0	4	3,200.00	0.00
16	*	Geocomposite	23200	SF	1.25	21,205	1,280	22,485	28,106.25	1,600.00
17	*	Drain Pipe, 4"	4080	LF	8.00	4,081	1,445	5,526	44,208.00	11,560.00
18	*	Perforated Pipe, 4"	3310	LF	9.00	3,191	185	3,376	30,384.00	1,665.00
19		18" PE Culvert	20	LF	40.00	20	0	20	800.00	0.00
20		Drain Pipe Concrete	34	EA	100.00	0	3	3	300.00	300.00
21	*	Pipe Cleanout Assmbly	74	EA	75.00	65	23	88	6,600.00	1,725.00
22	*	Appurt., 4" Type 1	29	EA	88.00	31	22	53	4,664.00	1,936.00
23	*	Appurt., 4" Type 2	104	EA	86.00	147	17	164	14,104.00	1,462.00
24		PVC Valves, 4"	10	EA	280.00	9	1	10	2,800.00	280.00
25		Service Hole, 72"	4	EA	2,790.00	4	0	4	11,160.00	0.00
26		Limestone Aggregate	270	CY	15.00	270	0	270	4,050.00	0.00
27	*	Cushion Fabric	8220	SY	2.85	7,545	0	7,545	21,503.25	0.00
28		Riprap	52	CY	40.00	26	16.5	42.5	1,700.00	660.00
29		Close Mine Opening-Adit	2	EA	750.00	2	1	3	2,250.00	750.00
30		Import Cover Soil	2800	CY	6.50	1,850	1,230	3,080	20,020.00	7,995.00
31		Fertilize and Seed	8	AC	950.00	0	15.5	15.5	14,725.00	14,725.00
32		Mulch	8	AC	650.00	0	15.5	15.5	10,075.00	10,075.00
33		Remove & Salvage Fence	5100	LF	0.35	2,747	2,353	5,100	1,785.00	823.55
34		Farm Fence(Type F-4M)	6420	LF	2.30	3,636	3,914	7,550	17,365.00	9,002.20
35		Farm Fence Gate, 16'	15	EA	70.00	5	7	12	840.00	490.00
36		Farm Fence(Type F-5M)	4295	LF	2.40	0	4,480	4,480	10,752.00	10,752.00
37		Erosion Contr.Mat,Vinyl	200	SY	7.50	0	200	200	1,500.00	1,500.00
38		Erosion Contr.Mat,Biodegr	2300	SY	5.25	0	1,020	1,020	5,355.00	5,355.00
39	**	Peat-OM	2375	CY	20.00	0	5,359	5,359	107,180.00	107,180.00
40	**	Limestone Aggr Mix W/Peat	264	CY	20.00	66	181	247	4,940.00	3,620.00
41	WD1	Old Pipe Cleanout	300	LF	1.70	0	275	275	467.50	467.50
42	WD2	Hand Close Adit Opening	1	EA	3000.00	0	1	1	3,000.00	3,000.00
43	WD3	Belt Mine Closing	1	EA	4865.00	0	1	1	4,865.00	4,865.00
		SUBTOTAL							712,678.51	290,516.19
		MATERIAL STORED ADJUSTMENT				17,410			0	(17,410.00)
									712,678.51	273,106.19

* Qty/Price adjusted by Change Order #1
** New Item from change Order #1

ITEMS FOR WHICH AER. (A) DIFFERS FROM (B)

(B) QUANTITIES AS REQUESTED BY SHARBONO

RBM 9/25/92

PAYMENT REQUEST NO. SEVEN

FROM 8/31/92 TO 1/25/93

PROJECT TITLE: CASCADE MINE DRAINAGE

LOCATION: CENTERVILLE "C"/STOCKETT MONT A/E or DSL-AMRB: 91-001

NAME OF CONTRACTOR: SHARBONO CONSTRCUTION, INC.

ADDRESS: 1826 NORTH MAIN, HELENA, MT 59601

SUMMARY OF PROJECT STATUS

Amount of Original Contract		$ 483,458.00
Change Order No. 1	$ 139,151.90	
Change Order No. ____	$	
Change Order No. ____	$	
Amount of Approved Change Order(s)		$ 139,151.90
TOTAL CONTRACT AMOUNT		$ 622,609.90

Pay Request No.	Amount of Request
ONE	62,065.71
TWO	68,127.75
THREE	41,275.82
FOUR	91,780.94
FIVE	132,364.87
SIX	200,097.92

Total Contract Amount Completed to Date	$ 697,608.16
Less Retainage (0 %)	$ -0-
TOTAL AMOUNT EARNED TO DATE	$ 697,608.16
Less Previous Payments	$ 595,713.01
AMOUNT DUE THIS PAYMENT	$ 101,895.15
Less 1% Tax	$ 1,018.95
TOTAL DUE CONTRACTOR	$ 100,876.20

I certify that this claim is correct and just in all respects and that payment or credit has not been received.

SHARBONO CONSTRUCTION, INC.
Contractor

By [signature]

Date 1/25/93

RECOMMENDED BY:

Engineer

By

Date

APPROVED BY:

Dept. of State Lands, Abandoned Mine Reclamation Bureau
Owner

By RESP. CNTR. 30107

Date OBJ. EXP. 2121

APPROVAL [signature]

DATE 2-2-93

CASCADE MINE DRAINAGE
DSL-AMRB NO. 91-001
PAY REQUEST NO. SEVEN

		Description	Contr Qty		Contr Unit Price	Prev Qty/Amt Req'd	Curr Qty/% Compl	Total Qty/% Compl To Date	Total Contract Amount Compl To Date	Amount Due This Payment
1		Mobilization. Bonding and Insurance	LS		10,000.00	10.000.00	0.00%	100.00%	10,000.00	0.00
2		Site Access	LS		12,880.00	12,880.00	0.00%	100.00%	12,880.00	0.00
3		Site Dewatering	LS		9,844.00	9,844.00	0.00%	100.00%	9,844.00	0.00
4	*	Site Earthwork	LS		49.025.00	49,025.00	0.00%	100.00%	49,025.00	0.00
5	*	Fine Grading	LS		3,546.90	3,546.90	0.00%	100.00%	3,546.90	0.00
6	*	Bentonite Seal	83900	SF	0.39	71,444	0	71,444	27,863.16	0.00
7	*	Membrane Liner-PVC	69600	SF	0.49	63,005	0	63,005	30,872.45	0.00
8		Membrane Liner-Hypalon	19580	SF	1.40	17,530	6,180	23,710	33,194.00	8,652.00
9	*	Filter Gravel	2795	CY	20.00	1,741	43	1,784	35,680.00	860.00
0		Peat	1407	CY	35.00	857.9	582.41	1,440.31	50,410.85	20,384.35
1		Peat-DCW	1065	CY	35.00	548.4	527.68	1,076.08	37,662.80	18,468.80
2	*	Hay Bale Dikes	600	EA	5.00	506	0	506	2,530.00	0.00
3		Lime Application	5	AC	1,800.00	12.6	0	12.6	22,680.00	0.00
4		Stock Tank, 1000 gal	1	EA	2,500.00	1	0	1	2,500.00	0.00
5	*	Weir Outlet Structure	4	EA	800.00	4	0	4	3,200.00	0.00
6	*	Geocomposite	23200	SF	1.25	22,485	0	22,485	28,106.25	0.00
7	*	Drain Pipe, 4"	4080	LF	8.00	5,526	0	5,526	44,208.00	0.00
8	*	Perforated Pipe, 4"	3310	LF	9.00	3,376	0	3,376	30,384.00	0.00
9		18" PE Culvert	20	LF	40.00	20	0	20	800.00	0.00
0		Drain Pipe Concrete	34	EA	100.00	3	0	3	300.00	0.00
1	*	Pipe Cleanout Assmbly	74	EA	75.00	88	0	88	6,600.00	0.00
2	*	Appurt., 4" Type 1	29	EA	88.00	53	0	53	4,664.00	0.00
3	*	Appurt., 4" Type 2	104	EA	86.00	164	0	164	14,104.00	0.00
4		PVC Valves, 4"	10	EA	280.00	10	0	10	2,800.00	0.00
5		Service Hole, 72"	4	EA	2,790.00	4	0	4	11,160.00	0.00
6		Limestone Aggregate	270	CY	15.00	270	0	270	4,050.00	0.00
7	*	Cushion Fabric	8220	SY	2.85	7,545	0	7,545	21,503.25	0.00
8		Riprap	52	CY	40.00	42.5	0	42.5	1,700.00	0.00
9		Close Mine Opening-Adit	2	EA	750.00	3	0	3	2,250.00	0.00
0		Import Cover Soil	2800	CY	6.50	3,080	0	3,080	20,020.00	0.00
1		Fertilize and Seed	8	AC	950.00	15.5	0	15.5	14,725.00	0.00
2		Mulch	8	AC	650.00	15.5	0	15.5	10,075.00	0.00
3		Remove & Salvage Fence	5100	LF	0.35	5,100	0	5,100	1,785.00	0.00
4		Farm Fence(Type F-4M)	6420	LF	2.30	7,550	0	7,550	17,365.00	0.00
5		Farm Fence Gate, 16'	15	EA	70.00	12	0	12	840.00	0.00
6		Farm Fence(Type F-5M)	4295	LF	2.40	4,480	0	4,480	10,752.00	0.00
7		Erosion Contr.Mat,Vinyl	200	SY	7.50	200	0	200	1,500.00	0.00
8		Erosion Contr.Mat,Biodegr	2300	SY	5.25	1,020	0	1,020	5,355.00	0.00
9	**	Peat-OM	2375	CY	20.00	2,193.5	2,051.5	4,245	84,900.00	41,030.00
0	**	Limestone Aggr Mix W/Peat	264	CY	20.00	247	0	247	4,940.00	0.00
1	WD1	Old Pipe Cleanout	300	LF	1.70	275	0	275	467.50	0.00
2	WD2	Hand Close Adit Opening	1	EA	3,000.00	1	0	1	3,000.00	0.00
3	WD3	Belt Mine Closing	1	EA	4,865.00	1	0	1	4,865.00	0.00
4	***	Extra Labor Item #13	1	LS	12,500.00	0	1	1	12,500.00	12,500.00
		SUBTOTAL							697,608.16	101,895.15

* Qty/Price adjusted by Change Order #1
** New Item from change Order #1
*** See DSL Correspondence

SHARBONO CONSTRUCTION. INC.
CASCADE MINE DRAINAGE
DSL-AMRB NO. 91-001
ADJUSTMENTS APPROVED SINCE BILL NO. 6

DESCRIPTION	UNIT PRICE	P.R.#6 CONTRACTOR REQUESTED QUANTITY	EXTENSION	P.R.#7 DSL-AMRB APPROVED QUANTITY	EXTENSION	ADJUSTMENT
BID ITEM #8 - HYPALON LINER	1.40	17,530.00	24,542.00	23,710.00	33,194.00	8,652.00
BID ITEM #9 - FILTER GRAVEL	20.00	2,512.00	50,240.00	1,784.00	35,680.00	(14,560.00)
BID ITEM #10 - PEAT	35.00	1,407.00	49,245.00	1,440.31	50,410.85	1,165.85
BID ITEM #11 - PEAT-DCW	35.00	1,065.00	37,275.00	1,076.08	37,662.80	387.80
BID ITEM #13 - LIME APPLICATION	1,800.00	13.12	23,616.00	12.60	22,680.00	(936.00)
BID ITEM #39 - PEAT OM	20.00	5,359.00	107,180.00	4,245.00	84,900.00	(22,280.00)
BID ITEM #44 - LABOR ITEM #13	12,500.00	0.00	0.00	1.00	12,500.00	12,500.00
			292,098.00		277,027.65	(15,070.35)
TOTAL PAY REQUEST - ALL ITEMS			712,678.51		697,608.16	(15,070.35)

RECEIVED
JUN 30 1992
ROBERT PECCIA
& ASSOCIATES

RECEIVED
JUN 24 1992
ST. OF LANDS

PAYMENT REQUEST NO. 1

FROM 4/20/92 TO 6/23/92

PROJECT TITLE: CASCADE MINE DRAINAGE, SCHEDULE II

LOCATION: STOCKETT, MT. MONT A/E or DSL-AMRB: 91-001

NAME OF CONTRACTOR: ED BOLAND CONST. INC.

ADDRESS: 2608 9TH AVE. N. GREAT FALLS, MT.

SUMMARY OF PROJECT STATUS

Amount of Original Contract	(38 325)	$ 61,625.00
Change Order No. 1	$ ~~22,300.~~	
Change Order No. ____	$	
Change Order No. ____	$	
Amount of Approved Change Order(s)		(38 325) $ ~~22,300~~
TOTAL CONTRACT AMOUNT		$ 22,300

Pay Request No.	Amount of Request
1	~~$ 14,435~~ $ 12,991.50

RDM 6/23/92

Total Contract Amount Completed to Date	$ 14,435.00
Less Retainage (10 %)	$ 1443.50
TOTAL AMOUNT EARNED TO DATE	$ 12,991.50
Less Previous Payments	$ 0
AMOUNT DUE THIS PAYMENT	$ 12,991.50
Less 1% Tax	$ 129.92
TOTAL DUE CONTRACTOR	$ 12861.58

I certify that this claim is correct and just in all respects and that payment or credit has not been received.

ED BOLAND CONST. INC.
Contractor

By [signature]

Date 6-9-92

RECOMMENDED BY:

ROBERT PECCIA & ASSOC
Engineer

By Robert B Morton

Date 6/23/92

APPROVED BY:

Dept. of State Lands, Abandoned Mine Reclamation Bureau
Owner

By [signature] Bonnie Lovelace

Date 6-26-92

Item No.	Description	Contract Quantity	Contract Unit Price	Previous Quantity Requested	Current Quantity Completed	Total Quantity Completed To Date	Total Contract Amount Completed to Date	Amount Due this Payment
1	MOBILIZATION	1	$1,000.	0%	100%	100%	100%	$1,000.
2	TRANSPLANT WETLAND VEGETATION	18,250	$.90	0%	46% 8,400	46%	$7560	$7560.
3	TRANSPLANT TREES	25	235.00	0%	100%	100%	$5875	$5875.
	Materials on Site (Attach Schedule)	–	–	$	$	——>	$	$1435
TOTAL							$	$14435

RECEIVED
SEP 2 1992
ROBERT PELLIA & ASSOCIATES

PAYMENT REQUEST NO. 2 - Final

FROM 6-23 TO 8-12-92

PROJECT TITLE: Cascade Mine Drainage, Sch. II

LOCATION: Stockett, MT MONT A/E or DSL-AMRB: 91-801

NAME OF CONTRACTOR: Ed Boland Construction, Inc.

ADDRESS: 2608 9th Ave. N., Great Falls, MT 59401

SUMMARY OF PROJECT STATUS

Amount of Original Contract		$ 61,625.00
Change Order No. 1	$ (38,325.00)	
Change Order No. 2	$ 6,355.00	
Change Order No. ____	$	
Amount of Approved Change Order(s)		$ (31,970.00)
TOTAL CONTRACT AMOUNT		$ 29,655.00

Pay Request No.	Amount of Request
1	$ 12,991.50
2	$ 16,663.50

Total Contract Amount Completed to Date	$ 29,655.00
Less Retainage (0 %)	$ 0%
TOTAL AMOUNT EARNED TO DATE	$ 29,655.00
Less Previous Payments	$ 12,991.50
AMOUNT DUE THIS PAYMENT	$ 16,663.50
Less 1% Tax	$ 166.64
TOTAL DUE CONTRACTOR	$ 16,496.86

I certify that this claim is correct and just in all respects and that payment or credit has not been received.

Ed Boland Construction, Inc.
Contractor

By Ed Boland

Date 8-25-92

RECOMMENDED BY:

Robert Pellia & Assoc.
Engineer

By Robert B Pellia

Date 9/21/92

APPROVED BY:

Dept. of State Lands, Abandoned Mine Reclamation Bureau
Owner

By Vic L Anderson

Date 9-22-92

Item No.	Description	Contract Quantity	Contract Unit Price	Previous Quantity Requested	Current Quantity Completed	Total Quantity Completed To Date	Total Contract Amount Completed to Date	Amount Due this Payment
1	MOB.	1 LS	$1,000	1 LS	0	100%	$1,000.00	0
2	Transplant wetland veg.	44,600 SF	$0.45	16,800 SF	27,800 SF	100%	$20,070.00	$12,510.00
3	Transplant Trees	25 ea	$235.00	25 ea	0	100%	$5,875.00	0
4	Change order #2, Item 2 work Directive Change #1, French Coulee work	1 LS	$2,710.00	0	1 LS	100%	$2,710.00	$2,710.00
	Materials on Site (Attach Schedule)	–	–	$	$	——>	$	$
TOTAL							$29,655.00	$15,220.00

Attachment D. Closeout Forms

CERTIFICATE OF SUBSTANTIAL COMPLETION

TO: Montana Deptment of State Lands - Abandoned Mine Reclamation Bureau OWNER

PROJECT TITLE: Cascade Mine Drainage, Schedule 1

MONT A/E or DSL-AMRB: 91-001
CONTRACT DATE: Aug 1, 1991
LOCATION: Cascade County, MT

SUBSTANTIAL COMPLETION DATE: 7/23/92
DSL INSPECTION DATE: 7/22/92
ENGINEER: Robert Peccia & Associates

PROJECT OR PART SHALL INCLUDE:
Schedule 1

PERFORMANCE BOND NO: B 1688308
DATE OF BOND: 8/1/91 Notice to Proceed
SURETY: Reliance Insurance Co.
MONTANA AGENT: Flynn Insurance Agency

CONTRACTOR: Sharbono Construction, Inc.
ADDRESS: 1826 N. Main
Helena, MT 59601
TELEPHONE NO: 442-8122

ADDRESS: P.O. Box 1256
Helena, MT ,59624

The Work performed under this Contract has been inspected by authorized representatives of the Owner, Contractor, and Engineer, and the Project (or specified part of the Project, as indicated above) is hereby declared to be substantially completed on the above date.

DEFINITION OF SUBSTANTIAL COMPLETION

The date of substantial completion of a project or specified area of a project is the date when the construction is sufficiently completed, in accordance with the contract documents, as modified by any change orders agreed to by the parties, so the Owner can occupy or utilize the project or specified area of the project for the use for which it was intended.

A tentative list of items to be completed is appended hereto. This list may not be exhaustive, and the failure to include an item on it does not alter the responsibility of the Contractor to complete all the Work in accordance with the Contract Documents.

ENGINEER: Robert Peccia & Associates

By Robert B Morton 8/27/92
Authorized Representative Date

The Contractor accepts the above Certificate of Substantial Completion and agrees to complete and correct the items on the tentative list within the time indicated.

CONTRACTOR: Sharbono Construction, Inc.

By Robert Sharbono 8-31-92
Authorized Representative Date

The Owner accepts the Project or specified area of the Project as substantially complete and will assume full possession of the project or specified area at 5:00 p.m. (time), on July 23,1992 (date). The responsibility for heat, utilities, security, and insurance under the Contract Documents shall be as set forth under "Remarks" below.

OWNER: Dept. of State Lands, AMRB

By Dan R Anderson 10-7-92
Authorized Representative Date

Remarks: (Attach additional sheet, if necessary)

Attachment to Certificate of Substantial Completion

CASCADE MINE DRAINAGE

PUNCH LIST ITEMS

The following items shall be completed prior to final payment and release of retainage:

1. Plywood used in the project service holes does not appear to be not pressure treated. This is specified in the project drawings, detail 5/5. We have contemplated two options to take care of this problem: a) replace the plywood, or b) coat the plywood with two coats of below ground wood preservative. Option a. is not preferred because the equipment necessary to remove the concrete cover to allow plywood replacement would require heavy equipment damage to the seedbed. The preferred option b. can be easily completed using a product called Wood Last 2, Manufactured by ATCO, and is available at Intermountain Lumber in Helena.

2. Weir Plates. Prior to weir plate installation one of the plexiglass weir plates was found to be broken and one was cracked. These should be replaced.

3. Farm fence. One portion of fencing at the Centerville C site near the stock tank needs a deadman/anchor installed.

4. The irrigation pipe used to supply water to the Centerville wetland needs to be removed.

WARRANTY ITEMS

Items which will be subject to warranty inspection and contractor repair under warranty include, but are not limited to, the following:

- Subsidence. Any areas where backfilling and/or burying was done which shows signs of subsidence will be reshaped and reclaimed.

- Erosion, Fertilizer, Seeding and Mulching. Eroded slopes and areas with insufficient seedling establishment will be reclaimed, including grading, seedbed preparation, fertilizing, seeding and mulching.

- Piping. Locations where pipe was installed will be tested by the Owner as part of the warranty inspection. Testing will be the same as that conducted during construction. If the testing results indicate repair is necessary Contractor shall repair the pipe and reclaim the corresponding disturbed area.

DEPARTMENT OF STATE LANDS

STAN STEPHENS, GOVERNOR

CAPITOL STATION

STATE OF MONTANA

(406) 444-2074

1625 ELEVENTH AVENUE
HELENA, MONTANA 59620

October 8, 1992

RECEIVED
OCT 13 1992
ROBERT PECCIA
& ASSOCIATES

Delbert Sharbono
Sharbono Construction
1826 N. Main
Helena, MT 59601

RE: Cascade Mine Drainage Reclamation Project

Dear Del:

Enclosed are your copies of Payment Request #6 and the Certificate of Substantial Completion. Payment Request #6 is being processed as modified by Robert Morton on 9/25/92.

I am not returning the Certificate of Acceptance that you signed on 9/29/92 as there is a punch list problem that needs to be attended to before the Department of State Lands accepts the project as totally completed. Manhole #2 at the Centerville wetland site does not have the bottom of the manhole graded such that the manhole drains completely. On 9/28/92 AMRB Staff was inside this manhole and found water puddled on the east side of the manhole while the drain on the west side was high and dry.

AMRB staff will be inside these manholes on a regular basis and the presence of water in the bottom is a nuisance and a possible safety hazard. The problem can be corrected by the addition of a small amount of grout or leveling cement to the east side of the manhole.

We are not withholding retainage on Payment Request #6 as this item was not on the punchlist attached to the Certificate of Substantial Completion. We will have to have this problem corrected before we can process any final payment request.

Sincerely,

John Koerth

John Koerth
Reclamation Program Supervisor
Abandoned Mine Reclamation Bureau
Reclamation Division

JK/ra

Enclosures

c. Robert Morton, Peccia & Associates

"AN EQUAL OPPORTUNITY EMPLOYER"

SHARBONO
CONSTRUCTION, INC.
GENERAL CONTRACTORS

DELBERT D. SHARBONO, PRESIDENT
1826 NORTH MAIN HELENA, MT 59601
(406) 442-8122 FAX (406) 442-8185

August 31, 1992

Mr. John Koerth
Department of State Lands - AMRB
1625 Eleventh Avenue
Helena, MT 59620

RE: Cascade Mine Drainage Project

Dear Mr. Koerth,

As an authorized official of SHARBONO CONSTRUCTION, INC., I certify that all applicable wage rates have been complied with on the Cascade Mine Drainage Project. Certified Payroll Reports have been submitted to the engineer on a monthly basis throughout the project.

By: Delbert Sharbono

Title: President

Subscribed and sworn to before me this 31st day of August, 1992.

Prudence K Ellis

Notary Public for the State of Montana
Residing at HELENA, MT
My commission expires 8/17/93.

SEP 1 1992

AFFIDAVIT ON BEHALF OF CONTRACTOR

STATE OF MONTANA)
: ss
COUNTY OF LEWIS & CLARK)

MONT A/E or DSL-AMRB: 91-001

DATE: 8/31/92

I certify to the best of my knowledge and belief that all work has been performed and materials supplied in strict conformance with the terms and conditions of the corresponding contract documents between STATE OF MONTANA, DSL-AMRB, the Owner, and SHARBONO CONSTRUCTION, INC the Contractor, dated 7/29/91 for the CASCADE MINE DRAINAGE Project, Mont A/E or DSL-AMRB 91-001, and further declare that all bills for materials, supplies, utilities, and for all other things furnished or caused to be furnished by the above-named Contractor and used in the execution of the above Contract have been fully paid, and there are no unpaid claims or demands of State Agencies, subcontractors, materialmen, mechanics, laborers or any others resulting from or arising out of work done or ordered to be done by said Contractor under the above-identified Contract.

In consideration of the prior and final payments made and all payments made for authorized changes, the Contractor releases and forever discharges the Owner from any and all obligations and liabilities arising by virtue of said Contract and authorized changes between the parties hereto, either verbal or in writing, and any and all claims and demands of every kind and character whatsoever against the Owner, arising out of or in any way relating to said Contract, and authorized changes.

This statement is made for the purpose of inducing the Owner to make Final Payment under the terms of the Contract, relying on the truth and statements contained therein.

Dated this 31st day of AUGUST, 1992, at HELENA, Montana.

CONTRACTOR: SHARBONO CONSTRUCTION, INC.

By: Robert Sharbono

Title: PRESIDENT

Subscribed and sworn to before me this 31st day of AUGUST, 1992.

Prudence K Wis

Notary Public for the State of Montana
Residing at HELENA
My commission expires 8/17/93

(SEAL)

Rev. 3/91

CONTRACTOR'S CERTIFICATE OF COMPLETION

TO (Owner): STATE OF MONTANA
DSL-AMRB
1625 ELEVENTH AVE
HELENA, MT 59620

DATE: 8/31/92

PROJECT TITLE: CASCADE MINE DRAINAGE

MONT A/E or DSL-AMRB: 91-001

ATTN: Engineer ROBERT PECCIA & ASSOC. CONTRACT DATE: 7/29/91

FROM: SHARBONO CONSTRUCTION, INC.
(Firm or Corporation)

This is to certify that I, DELBERT D. SHARBONO, am an authorized official of SHARBONO CONSTRUCTION, INC., working in the capacity of PRESIDENT and have been properly authorized by said firm or corporation to sign the following statements pertaining to the subject contract:

I know of my own personal knowledge, and do hereby certify, that the work of the contract described above has been performed, and materials used and installed in every particular, in accordance with, and in conformity to, the Contract Plans and Specifications.

The contract work is now complete in all parts and requirements and ready for your substantial completion inspection.

I understand that neither the determination of the Engineer that the work is complete nor the acceptance thereof by the Owner shall operate as a bar to claim against the Contractor under the terms of the guarantee provisions of the Contract Documents.

CONTRACTOR: SHARBONO CONSTRUCTION, INC.

By: Delbert D Sharbono
Title PRESIDENT

Distribution:
1. Project Manager
2. Field Office
3. File

Rev. 3/91

CERTIFICATE OF SUBSTANTIAL COMPLETION

SEP 4 1992

ROBERT - -

TO: MT Department of State Lands, Abandoned Mine Rec. Bureau OWNER

PROJECT TITLE: Cascade Mine Drainage

MONT A/E or DSL-AMRB: 91-001

CONTRACT DATE: Aug 26, 1991

LOCATION: Cascade Co. MT

SUBSTANTIAL COMPLETION DATE: August 12, 1992

DSL INSPECTION DATE: Scheduled for 8/28/92

ENGINEER: Robert Peccia & Associates

PROJECT OR PART SHALL INCLUDE:
Schedule 2

PERFORMANCE BOND NO: 3 50 85 81

DATE OF BOND: 8/13/91

SURETY: Great American Insurance Co.

CONTRACTOR: Ed Bolland Construction, Inc.

ADDRESS: 2608 9th Ave. North
Great Falls, MT 59401

TELEPHONE NO: 761-1063

MONTANA AGENT: Flynn Insurance Agency

ADDRESS: P.O. Box 1256
Helena, MT 59624

The Work performed under this Contract has been inspected by authorized representatives of the Owner, Contractor, and Engineer, and the Project (or specified part of the Project, as indicated above) is hereby declared to be substantially completed on the above date.

DEFINITION OF SUBSTANTIAL COMPLETION

The date of substantial completion of a project or specified area of a project is the date when the construction is sufficiently completed, in accordance with the contract documents, as modified by any change orders agreed to by the parties, so the Owner can occupy or utilize the project or specified area of the project for the use for which it was intended.

A tentative list of items to be completed is appended hereto. This list may not be exhaustive, and the failure to include an item on it does not alter the responsibility of the Contractor to complete all the Work in accordance with the Contract Documents.

ENGINEER: Robert Peccia & Associates

By Robert B Morton 8/26/92
Authorized Representative Date

The Contractor accepts the above Certificate of Substantial Completion and agrees to complete and correct the items on the tentative list within the time indicated.

CONTRACTOR: Ed Bolland Construction, Inc.

By [signature] 8/29/92
Authorized Representative Date

The Owner accepts the Project or specified area of the Project as substantially complete and will assume full possession of the project or specified area at _____ (time), on _____ (date). The responsibility for heat, utilities, security, and insurance under the Contract Documents shall be as set forth under "Remarks" below.

OWNER: Dept. of State Lands - AMRB

By Vic R Anderson 9/22/92
Authorized Representative Date

Remarks: (Attach additional sheet, if necessary)

Rev. 3/91

CERTIFICATE OF ACCEPTANCE

TO: Department of State Lands-Abandoned Mine Reclamation Bureau OWNER

PROJECT TITLE: Cascade Mine Drainage - Schedule 2

MONT A/E or DSL-AMRB: 91-001

CONTRACT DATE: August 26, 1991

LOCATION: Cascade County Montana

FINAL ACCEPTANCE DATE: September 21, 1992

DSL INSPECTION DATE: August 31, 1992

ENGINEER: Robert Peccia & Assoc.

PROJECT OR PART SHALL INCLUDE:
Schedule 2

PERFORMANCE BOND NO: 3 50 85 81

DATE OF BOND: 8/13/91

SURETY: Great American Insurance Co.

MONTANA AGENT: Flynn Insurance Agency

CONTRACTOR: Ed Bolland Construction, Inc.

ADDRESS: 2608 9th Ave North
Great Falls MT, 59401

TELEPHONE NO: (406) 761-1063

ADDRESS: P.O. Box 1256
Helena, MT 59624

The Work performed under this Contract has been inspected by authorized representatives of the Owner, Contractor, and Engineer, and the Project (or specified part of the Project, as indicated above) is hereby declared to be totally completed and accepted on the above date.

ENGINEER: Robert Peccia & Associates

By _____ 9/21/92
Authorized Representative Date

The Contractor accepts the above Certificate of Acceptance and agrees to abide by the conditions of the one-year warranty period which began on the substantial completion date.

CONTRACTOR: Ed Bolland Construction, Inc.

By _____ 9-22-92
Authorized Representative Date

The Owner accepts the Project as totally complete, and final payment is due to the Contractor as provided in the contract documents.

OWNER: _____

By _____
Authorized Representative Date

Rev. 3/91

ROBERT
PECCIA
& ASSOCIATES

Civil, Transportation
& Environmental
Engineers

September 21, 1992

Barry Bolland
Ed Bolland Construction, Inc.
2608 9th Ave. North
Great Falls, MT 59401

RE: Cascade Mine Drainage - Schedule 2, DSL-AMRB 91-001

Dear Joe:

Enclosed is a copy of the project closeout letter submitted to AMRB. Thanks for your effort on completing this project.

The last closeout item to be dealt with is the enclosed Certificate of Acceptance. Please review, sign and send the four copies back to me and we will transmit them to DSL.

We will be keeping an eye on this site for problems which might develop within the one year construction warranty period which is in effect until August 12, 1993.

Thank you for your good help and cooperation. Contact me with any questions or comments.

Sincerely,

ROBERT PECCIA & ASSOCIATES

Robert B. Morton
Reclamation Scientist

cc: John Koerth, DSL-AMRB

P.O. Box 5653
825 Custer
Helena, Montana 59604
(406) 442-8160
FAX (406) 443-6324

CERTIFICATE OF ACCEPTANCE

TO: Department of State Lands-Abandoned Mine Reclamation Bureau OWNER

PROJECT TITLE: Cascade Mine Drainage - Schedule 2

MONT A/E or DSL-AMRB: 91-001
CONTRACT DATE: August 26, 1991
LOCATION: Cascade County Montana

FINAL ACCEPTANCE DATE: September 21, 1992
DSL INSPECTION DATE: August 31, 1992
ENGINEER: Robert Peccia & Assoc.

PROJECT OR PART SHALL INCLUDE:
Schedule 2

PERFORMANCE BOND NO: 3 50 85 81
DATE OF BOND: 8/13/91
SURETY: Great American Insurance Co.
MONTANA AGENT: Flynn Insurance Agency
ADDRESS: P.O. Box 1256
Helena, MT 59624

CONTRACTOR: Ed Bolland Construction, Inc.
ADDRESS: 2608 9th Ave North
Great Falls MT, 59401
TELEPHONE NO: (406) 761-1063

The Work performed under this Contract has been inspected by authorized representatives of the Owner, Contractor, and Engineer, and the Project (or specified part of the Project, as indicated above) is hereby declared to be totally completed and accepted on the above date.

ENGINEER: Robert Peccia & Associates

By _____ 9/21/92
Authorized Representative Date

The Contractor accepts the above Certificate of Acceptance and agrees to abide by the conditions of the one-year warranty period which began on the substantial completion date.

CONTRACTOR: Ed Bolland Construction, Inc.

By _____
Authorized Representative Date

The Owner accepts the Project as totally complete, and final payment is due to the Contractor as provided in the contract documents.

OWNER: _____

By _____
Authorized Representative Date

ROBERT
PECCIA
& ASSOCIATES

Civil, Transportation
& Environmental
Engineers

September 21, 1992

John Koerth
Abandoned Mine Reclamation Bureau
Montana Dept. of State Lands
1625 Eleventh Ave.
Helena, MT 59620

RE: Cascade Mine Drainage, DSL-AMRB 91-001, Schedule 2, Bolland Construction, Final Payment Request and Project Closeout

Dear John:

Enclosed are the following items required to closeout Schedule 2 of the Cascade Mine Drainage project.

- Final Pay Request No.2
- Change Order No.2 (final)
- Affidavit on Behalf of Contractor
- Contractors Certificate of Completion
- Certificate of Substantial Completion
- Consent of Surety Company to Final Payment
- Letter certifying wage rates complied with on the project

The Pay Request, Change Order and Certificate of Substantial Completion all require AMRB signature. Please send me a copy of these finalized documents for my file. The Certificate of Acceptance has been forwarded to Bolland for their signature and upon receipt will be sent to you for your signature.

I am happy to say that this portion of the project, Schedule 2, is complete in accordance with the Contract requirements. Based on the date established in the Certificate of Substantial Completion we will plan on completing an 11 month warranty inspection in July 1993. The final project report will be submitted to you within the next few months.

Call with any questions or comments.

Sincerely,

ROBERT PECCIA & ASSOCIATES

Bob Morton

Robert B. Morton
Reclamation Scientist

cc: Barry Bolland, Bolland Construction

P.O. Box 5653
825 Custer
Helena, Montana 59604
(406) 442-8160
FAX (406) 443-6324

CONSENT OF SURETY COMPANY TO FINAL PAYMENT

(From AIA Document G707)

OWNER ☐
ENGINEER ☐
CONTRACTOR ☐
SURETY ☐
OTHER

PROJECT: CASCADE MINE DRAINAGE-SCHEDULE 2
(name, address)

TO (Owner)
STATE OF MONTANA
ABANDONED MINE RECLAMATION BUREAU
CAPITAL STATION
HELENA, MT 59620

MONT A/E or
DSL-AMRB NO.: 91-001

CONTRACT FOR: MINE DRAINAGE

CONTRACT DATE: AUGUST 26, 1991

CONTRACTOR: ED BOLAND CONSTRUCTION
2608 9TH AVE. NORTH, GREAT FALLS, MT 59401

In accordance with the provisions of the contract between the Owner and the Contractors indicated above, the GREAT AMERICAN INSURANCE COMPANY (here insert name and address of Surety Company), SURETY COMPANY, on bond of ED BOLAND CONSTRUCTION, INC. (here insert name and address of Contractor), CONTRACTOR, hereby approves of the final payment to the Contractor, and agrees that final payment to the Contractor shall not relieve the Surety Company of any of its obligations to STATE OF MONTANA (here insert name and address of Owner), OWNER, as set forth in the said Surety Company's bond.

IN WITNESS WHEREOF, the Surety Company has hereunto set its hand this 31ST day of AUGUST, 19 92.

GREAT AMERICAN INSURANCE COMPANY
Surety Company

Attest: Witness: [illegible]
(Seal)

Signature of Authorized Representative

LISA W. ANDERSON, ATTORNEY-IN-FACT
Title

NOTE: This form is to be used as a companion document to the Affidavit on Benalf of Contractor (current edition).

Rev. 3/91

GREAT AMERICAN INSURANCE COMPANY

The number of persons authorized by
this power of attorney is not more than FOUR

No. 0 13325

POWER OF ATTORNEY

KNOW ALL MEN BY THESE PRESENTS: That the GREAT AMERICAN INSURANCE COMPANY, a corporation organized and existing under and by virtue of the laws of the State of Ohio, does hereby nominate, constitute and appoint the person or persons named below its true and lawful attorney-in-fact, for it and in its name, place and stead to execute in behalf of the said Company, as surety, any and all bonds, undertakings and contracts of suretyship, or other written obligations in the nature thereof; provided that the liability of the said Company on any such bond, undertaking or contract of suretyship executed under this authority shall not exceed the limit stated below.

Name	Address	Limit of Power
GORDON McMANUS LORI WALKER JOHN D. LEAF LISA W. ANDERSON	ALL OF GREAT FALLS, MONTANA	ALL UNLIMITED

This Power of Attorney revokes all previous powers issued in behalf of the attorney(s)-in-fact named above.

IN WITNESS WHEREOF the GREAT AMERICAN INSURANCE COMPANY has caused these presents to be signed and attested by its appropriate officers and its corporate seal hereunto affixed this 30th day of June, 19 92

Attest GREAT AMERICAN INSURANCE COMPANY

STATE OF OHIO, COUNTY OF HAMILTON – ss:

On this 30th day of June, 1992, before me personally appeared WILLIAM J. MANEY, to me known, being duly sworn, deposes and says that he resided in Cincinnati, Ohio, that he is the Vice President of the Great American Insurance Company, the Company described in and which executed the above instrument; that he knows the seal; that it was so affixed by authority of his office under the By-Laws of said Company, and that he signed his name thereto by like authority.

This Power of Attorney is granted by authority of the following resolutions adopted by the Board of Directors of Great American Insurance Company by unanimous written consent dated August 20, 1979.

RESOLVED: That the President, the several Vice Presidents and Assistant Vice Presidents, or any one of them, be and hereby is authorized, from time to time, to appoint one or more Attorneys-In-Fact to execute in behalf of the Company, as surety, any and all bonds, undertakings and contracts of suretyship, or other written obligations in the nature thereof; to prescribe their respective duties and the respective limits of their authority; and to revoke any such appointment at any time.

RESOLVED FURTHER: That the Company seal and the signature of any of the aforesaid officers may be affixed by facsimile to any power of attorney or certificate of either given for the execution of any bond, undertaking, contract or suretyship, or other written obligation in the nature thereof, such signature and seal when so used being hereby adopted by the Company as the original signature of such officer and the original seal of the Company, to be valid and binding upon the Company with the same force and effect as though manually affixed.

CERTIFICATION

I, RONALD C. HAYES, Assistant Secretary of the Great American Insurance Company, do hereby certify that the foregoing Power of Attorney and the Resolutions of the Board of Directors of August 20, 1979 have not been revoked and are now in full force and effect.

Signed and sealed this 31ST day of AUGUST, 19 92

CONTRACTOR'S CERTIFICATE OF COMPLETION

TO (Owner): STATE OF MONTANA DATE: SEPT. 1 / 1992

ABANDONED MINE PROJECT TITLE: CASCADE

RECLAMATION BUREAU MINE DRAINAGE

DSL-AMRB: 91-001 SCH. 2

ATTN: Engineer ROBERT PECCIA CONTRACT DATE: _____

FROM: ED BOLAND CONST. INC.
(Firm or Corporation)

This is to certify that I, BARRY BOLAND, am an authorized official of ED BOLAND CONST. INC., working in the capacity of VICE PRES and have been properly authorized by said firm or corporation to sign the following statements pertaining to the subject contract:

I know of my own personal knowledge, and do hereby certify, that the work of the contract described above has been performed, and materials used and installed in every particular, in accordance with, and in conformity to, the Contract Plans and Specifications.

The contract work is now complete in all parts and requirements and ready for your final inspection.

I understand that neither the determination of the Engineer that the work is complete nor the acceptance thereof by the Owner shall operate as a bar to claim against the Contractor under the terms of the guarantee provisions of the Contract Documents.

CONTRACTOR: Barry Boland

By: VICE PRES.
Title

Distribution:
1. Project Manager
2. Field Office
3. File

AFFIDAVIT ON BEHALF OF CONTRACTOR

STATE OF MONTANA)
: ss
COUNTY OF CASCADE)

MONT A/E or DSL-AMRB: 91-001

DATE: AUGUST 31, 1992

I certify to the best of my knowledge and belief that all work has been performed and materials supplied in strict conformance with the terms and conditions of the corresponding contract documents between STATE OF MONTANA, the Owner, and ED BOLAND CONST. INC, the Contractor, dated AUGUST 31, 1992 for the CASCADE MINE DRAINAGE Project, Mont A/E or DSL-AMRB 91-001, and further declare that all bills for materials, supplies, utilities, and for all other things furnished or caused to be furnished by the above-named Contractor and used in the execution of the above Contract have been fully paid, and there are no unpaid claims or demands of State Agencies, subcontractors, materialmen, mechanics, laborers or any others resulting from or arising out of work done or ordered to be done by said Contractor under the above-identified Contract.

In consideration of the prior and final payments made and all payments made for authorized changes, the Contractor releases and forever discharges the Owner from any and all obligations and liabilities arising by virtue of said Contract and authorized changes between the parties hereto, either verbal or in writing, and any and all claims and demands of every kind and character whatsoever against the Owner, arising out of or in any way relating to said Contract, and authorized changes.

This statement is made for the purpose of inducing the Owner to make Final Payment under the terms of the Contract, relying on the truth and statements contained therein.

Dated this 1ST day of SEPT., 1992, at GREAT FALLS, Montana.

CONTRACTOR: ED BOLAND CONST INC.

By: [signature]
Title: VICE PRES.

Subscribed and sworn to before me this 1ST day of SEPT., 1992.

[signature]
Notary Public for the State of Montana
Residing at GREAT FALLS
My commission expires OCT. 7, 1992

(SEAL)

Rev. 3/91

Ed Boland Construction Inc.

Bus. (406) 761-1063
Res. (406) 452-2251

4601 7th Ave. So.
Great Falls, MT 59405

9-1-92

TO WHOM IT MAY CONCERN:

BOLAND CONST. INC. HAS COMPLIED WITH ALL APPLICABLE WAGE RATES FOR THE CASCADE MINE DRAINAGE PROJECT.

AMRB 91-001 SCH. 2

THANK YOU,

BARRY BOLAND

CHANGE ORDER

ORDER NO. 2 - Final

PROJECT TITLE: Cascade Mine Drainage - Schedule 2 - Base Bid

MONT A/E or DSL-AMRB: 91-001

CONTRACT DATE: Aug, 26, 1991 Date of Agreement

OWNER: Mt Dept. of State Lands - Abandoned Mine Reclamation Bureau

CONTRACTOR: Ed Bolland Construction, Inc.

Change Orders must be accompanied by an itemized cost breakdown. You are hereby requested to comply with the following changes from the Contract Documents. (Show separate costs for materials, labor, equipment, and miscellaneous. Show percent where applicable.)

ITEM NO.	DESCRIPTION OF CHANGES - ESTIMATED QUANTITIES & UNITS	COST OF CHANGES					TOTAL COST
		MAT'LS.	LABOR	EQUIP.	MISC.	TOTAL UNIT COST	
1	Bid Item 2. Transplant Wetland Vegetation - Increase Quantity from total 36,500 SF to 44,600 SF (22,300 total cattail plants).	--	--	--	--	$0.45/SF ($0.90/ plant)	3645.00
2	Work Directive Change 1. Modifications and repair of French Coulee Piping - Increase project amount by 1 LS @ $2,710.00.	--	--	--	--	$2,710.00	2710.00
						TOTAL COST - MATERIALS, LABOR, EQUIPMENT & MISC.	$6,355.00
						OVERHEAD & PROFIT @ ____%	__0__
						GRAND TOTAL - THIS CHANGE ORDER	$6,355.00

Original Contract Price	$61,625.00
Current Contract Price Adjusted by Previous Change Order	$23,300.00
Cost this Change Order (+ or -)	+ $6,355.00
New Contract Price including this Change Order	$29,655.00

The completion date as set forth in the Contract Documents shall be (unchanged, increased, decreased) by 18 calendar days.

The date for completion of all work will be August 12, 1992.

Description and Justification for Change:

1. Bid Item 2. Transplant Wetland Vegetation - Increase in quantity reconciles bid quantities to reflect actual quantities installed.

2. Work Directive Change 1. Modifications and repair of French Coulee Piping - Increase in project amount by 1 LS @ quoted cost, see Work Directive 1.

SURETY CONSENT

The Surety hereby consents to the aforementioned Contract Change Order and agrees that its bond or bonds shall apply and extend to the Contract as thereby modified or amended per this Change Order. The Principal and the Surety further agree that on or after execution of this consent, the penalty of the applicable Performance Bonds or Bonds is hereby increased by $6,355.00---- (100% of the Change Order amount) and the penalty of the applicable Labor and Material Bond or Bonds is hereby increased by $ 6,355.00--- (100% of the Change Order amount).

COUNTERSIGNED BY MONTANA RESIDENT AGENT

SURETY

FLYNN INSURANCE AGENCY

GREAT AMERICAN INSURANCE COMPANY

GORDON D. MCMANUS

By: LISA W. ANDERSON Seal

Recommended by: Robert Peccia & Assoc. Robert B Peccia 8/27/92
Engineer Date

Accepted by: Ed Bolland Const. Ed Bolland 8/28/92
Contractor Date

Approved by: DSL-AMRB
Owner Date

CERTIFICATE OF SUBSTANTIAL COMPLETION

SEP ~ 1992

ROBERT ~~~~

TO: MT Department of State Lands, Abandoned Mine Rec. Bureau OWNER

PROJECT TITLE: Cascade Mine Drainage

MONT A/E or DSL-AMRB: 91-001
CONTRACT DATE: Aug 26, 1991
LOCATION: Cascade Co. MT

SUBSTANTIAL COMPLETION DATE: August 12, 1992
DSL INSPECTION DATE: Scheduled for 8/28/92
ENGINEER: Robert Peccia & Associates

PROJECT OR PART SHALL INCLUDE:
Schedule 2

PERFORMANCE BOND NO: 3 50 85 81
DATE OF BOND: 8/13/91
SURETY: Great American Insurance Co.

CONTRACTOR: Ed Bolland Construction, Inc.
ADDRESS: 2608 9th Ave. North
Great Falls, MT 59401
TELEPHONE NO: 761-1063

MONTANA AGENT: Flynn Insurance Agency
ADDRESS: P.O. Box 1256
Helena, MT 59624

The Work performed under this Contract has been inspected by authorized representatives of the Owner, Contractor, and Engineer, and the Project (or specified part of the Project, as indicated above) is hereby declared to be substantially completed on the above date.

DEFINITION OF SUBSTANTIAL COMPLETION

The date of substantial completion of a project or specified area of a project is the date when the construction is sufficiently completed, in accordance with the contract documents, as modified by any change orders agreed to by the parties, so the Owner can occupy or utilize the project or specified area of the project for the use for which it was intended.

A tentative list of items to be completed is appended hereto. This list may not be exhaustive, and the failure to include an item on it does not alter the responsibility of the Contractor to complete all the Work in accordance with the Contract Documents.

ENGINEER: Robert Peccia & Associates

By _____ 8/26/92
Authorized Representative Date

The Contractor accepts the above Certificate of Substantial Completion and agrees to complete and correct the items on the tentative list within the time indicated.

CONTRACTOR: Ed Bolland Construction, Inc.

By _____ 8/27/92
Authorized Representative Date

The Owner accepts the Project or specified area of the Project as substantially complete and will assume full possession of the project or specified area at _____ (time), on _____ (date). The responsibility for heat, utilities, security, and insurance under the Contract Documents shall be as set forth under "Remarks" below.

OWNER: Dept. of State Lands - AMRB

By _____
Authorized Representative Date

Remarks: (Attach additional sheet, if necessary)

Rev. 3/91

PAYMENT REQUEST NO. 2 - Final

FROM 6-23 TO 8-12-92

PROJECT TITLE: Cascade Mine Drainage, Sch. II

LOCATION: Stockett, MT MONT A/E or DSL-AMRB: 91-001

NAME OF CONTRACTOR: Ed Boland Construction, Inc.

ADDRESS: 2608 9th Ave. N., Great Falls, MT 59401

SUMMARY OF PROJECT STATUS

Amount of Original Contract		$ 61,625.00
Change Order No. 1	$ (38,325.00)	
Change Order No. 2	$ 6,355.00	
Change Order No. ____	$ ____	
Amount of Approved Change Order(s)		$ (31,970.00)
TOTAL CONTRACT AMOUNT		$ 29,655.00

Pay Request No.	Amount of Request
1	$ 12,991.50
2	$ 16,663.50

Total Contract Amount Completed to Date	$ 29,655.00
Less Retainage (0 %)	$ 0%
TOTAL AMOUNT EARNED TO DATE	$ 29,655.00
Less Previous Payments	$ 12,991.50
AMOUNT DUE THIS PAYMENT	$ 16,663.50
Less 1% Tax	$ 166.64
TOTAL DUE CONTRACTOR	$ 16,496.86

I certify that this claim is correct and just in all respects and that payment or credit has not been received.

Ed Boland Construction, Inc.
Contractor

By Ed Boland

Date 8-25-92

RECOMMENDED BY:

Robert Pellia & Assoc.
Engineer

By Robert B Pellia

Date 9/21/92

APPROVED BY:

Dept. of State Lands, Abandoned Mine Reclamation Bureau
Owner

By ____

Date ____

Item No.	Description	Contract Quantity	Contract Unit Price	Previous Quantity Requested	Current Quantity Completed	Total Quantity Completed To Date	Total Contract Amount Completed to Date	Amount Due this Payment
1	MOB.	1 LS	$1,000	1 LS	0	100%	$1,000.00	0
2	Transplant wetland Veg.	44,600 SF	$0.45	16,800 SF	27,800 SF	100%	$20,070.00	$12,510.00
3	Transplant Trees	25 ea	$235.00	25 ea	0	100%	$5,875.00	0
4	Change order #2, Item 2 work Directive Change #1, French Coulee work	1 LS	$2,710.00	0	1 LS	100%	$2,710.00	$2,710.00
	Materials on Site (Attach Schedule)	--	--	$	$	——>	$	$
TOTAL							$29,655.00	$15,220.00

Attachment E. Analysis of Consultant Costs Incurred

Analysis of Consultant Costs Incurred
For The Montana Department of State Lands
Abandoned Mine Reclamation Bureau
AMR Project Number: DSL-AMRB No. 91-001
Project Title: Cascade Mine Drainage

As of March 8, 1993

Engineering and Construction Services		Amount
Design Engineering:		
1990 Contract - RPA #90-30.13		$54,443.24
Subtotal Design Engineering Cost:		$54,443.24
Construction Engineering:		
1991 Contract - RPA #91-30.7		$136,279.81
1992 Contract - RPA #92-30.4		$13,705.46
Subtotal Construction Engineering Cost:		$149,985.27
Total Project Engineering Cost:		**$204,428.51**
Construction Costs:		
Sharbono Construction/Bolland Construction	**$727,263.16**	

Percentage of Engineering Fees to Construction Costs:

Design Engineering / Construction Cost	*7.49%*
Construction Engineering / Construction Cost	*20.62%*
Total Engineering Cost / Construction Cost	*28.11%*

Attachment F. Operation and Maintenance Plan

OPERATIONS AND MAINTENANCE PLAN

CASCADE MINE DRAINAGE

Department of State Lands
Abandoned Mine Reclamation Bureau
Project Number 91-001

Location

Centerville, Stockett & Belt, Montana
Sec. 18, 19 & 36, Township 19 North, Range 4 East and
Sec. 26, Township 19 North, Range 6 East
Southeast of Great Falls
In Cascade County, Montana

December 1992

Robert Peccia & Associates
Helena, MT

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OPERATIONS & MAINTENANCE PLAN

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1. INTRODUCTION AND OBJECTIVES

This Operations and Maintenance Plan is developed for the Cascade Mine Drainage Project. The Abandoned Mine Reclamation project sites specifically discussed are the Centerville "C" site and the Stockett SE site. This plan is Attachment F of the Cascade Mine Drainage Final Report. If this plan is copied out of the Final Report, an important item which should be included with the plan is the record drawings (Attachment G of the Final Report).

The Centerville site is situated on a west facing slope of Sand Coulee Creek in the NE 1/4 of Sec. 19 and SE 1/4 of Sec. 18, Township 19 North, Range 4 East (Latitude 47°23′35″, Longitude 111°08′20″). The Stockett site is situated on the north end of a north/south trending ridge with east, north and west facing slopes and is near the confluence of Cottonwood Creek and an unnamed drainage. The legal description of the Stockett site is the SE 1/4 of Sec. 36, Township 19 North, Range 4 East (Latitude 47°21′20″, Longitude 111°09′40″).

The main items installed at the Centerville site include a system of interceptor drains, a limestone trench, and a three cell wetland. At Stockett the main installed items are a large interceptor drain system, two limestone trenches and two wetland channels.

The primary objectives of this plan are 1) to describe the operating capabilities of the acid mine drainage (AMD) control and treatment systems constructed at Centerville and Stockett sites, 2) suggest maintenance and sampling for the systems, and 3) discuss AMD chemical relationships and theoretical treatment system longevity.

2. OPERATIONS

All service holes, pipe cleanout assemblies and the Centerville stock tank valve are locked to reduce unauthorized entry. All of these locks are keyed alike. Keys are available from the AMRB.

A. Centerville "C" The interceptor drains were installed on the hill of the east side of the constructed area. Locations of the 5 separate interceptor lines installed are shown on the Record Drawing in Attachment G. Details of a typical interceptor drain are also included in Attachment G. The geocomposite and perforated pipe interceptors are all routed to a 4 inch PVC pipeline which existed prior to this project. This pipeline runs to concrete service hole No. 1, located at the base of the east hill adjacent to the site's north drainage. A surface water collection basin is located in this north drainage. There is a water control weir structure connected to the basin. A 4 inch pvc pipeline flows from this basin to service hole No. 1.

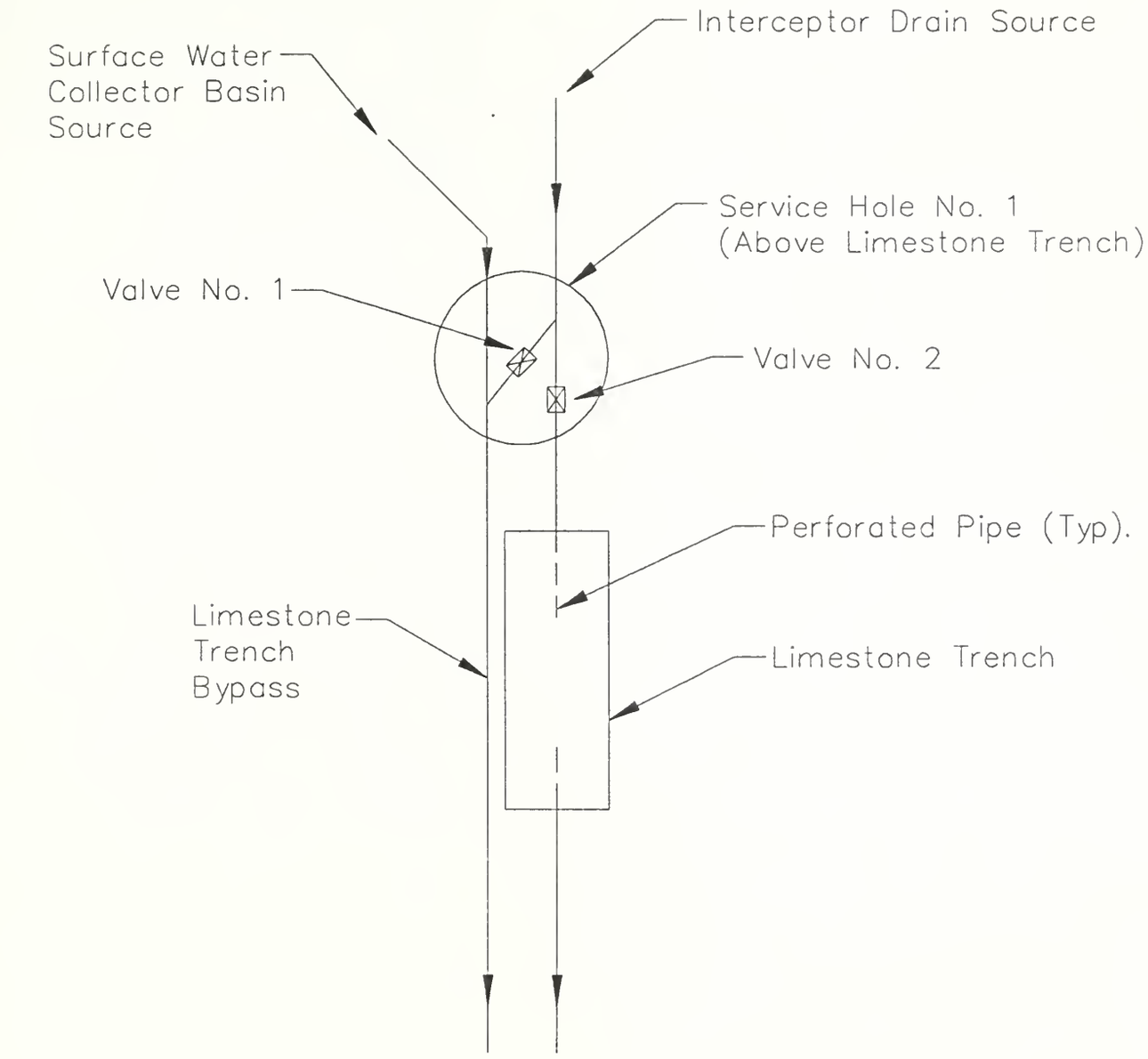
The **surface water collection basin** was installed to tight tolerances which allow normal year round flows to enter the treatment system but should exclude major flood events. Typically, normal flows amount to less than one gallon per minute of water. The weir plate in the weir structure is currently set at 2 inches below the elevation of the collection basin spillway. The current setting of this weir plate will allow about 7 gpm of water to enter the system. If more than 7 gpm of water is being collected by the basin, the excess water will flow out the basin over the spillway. To further limit the quantity of water to enter the system from the basin, a few simple options are available: 1) Leave the weir plate in its current location and glue about a 4x12 inch strip of plexiglass to the plate. This strip can be placed at 2 inches above and perpendicular to the bottom of the apex of the 90° weir plate notch, across the opening. This will essentially limit any flood water to the 2 inch high opening. 2) Raise the weir plate, by installing a new one, to something less than 2 inches as currently set. 3) Stop flow completely by installing a weir plate which is not notched or placing an expanding plug in the structure outlet pipe (one is currently installed in the weir structure outlet from wetland cell 1).

Service hole No.1 has two inflow pipes (sources) and two outflow pipes. Figure 1-O&M depicts the installed system. The inflows, as described above, are from the collector basin and the interceptors. The service hole outflow pipes are to the limestone trench or the limestone trench bypass. The water from the collector basin can only bypass the limestone trench. Only water from the interceptor drain source can be routed to the limestone trench. There are two options for the water from the interceptors in this service hole: 1) to flow into the limestone trench or 2) to bypass the limestone trench. To properly allow flow into the limestone trench, valve No.2 needs to be opened and then valve No.1 closed. To properly allow flow to bypass the limestone trench, valve No.1 needs to be opened and then valve No.2 closed. If valve No.2 is closed, no water will be able to enter the limestone trench. If both valves No.1 and 2 are closed, water will back up the interceptor source input line.

Proper system operations involve always leaving an "out" for piped water. This means always open the valve in which you wish to change flow direction prior to closing the valve for which you wish to stop flow. Valves should be turned slowly to reduce water hammer. Do not stand on piping in the service holes. A valve is "open" when the turning handle is in line or parallel to the flow direction or piping. A valve is "closed" when the turning handle is perpendicular to the flow direction or piping. The installed valves are designed to be dismantled if necessary. Taking a valve apart will require the use of a pipe wrench. All valve opening and closing can be done without the use of tools with the exception of the valve at the Centerville wetland stock tank which requires a "T" handle. The AMRB has this handle. If necessary, the ball valves used on this project are effective in throttling flow and have no mechanical obstruction in the valve when open. Product literature on the valves is included in the appendix to this O&M Plan (Attachment F).

All the project **limestone trenches** are operated by the up-gradient service hole valves. They are designed to be full of water when the valving is turned open to allow flow into them. At the inlet end of the limestone trenches, pipe connections are about 6 inches from the bottom. The outlet pipe connections are about 6 inches from the top of the limestone trenches. To keep the limestone trenches full of water, the outlet piping invert elevation at some point down gradient of the trench is the same elevation as the top of the trench.

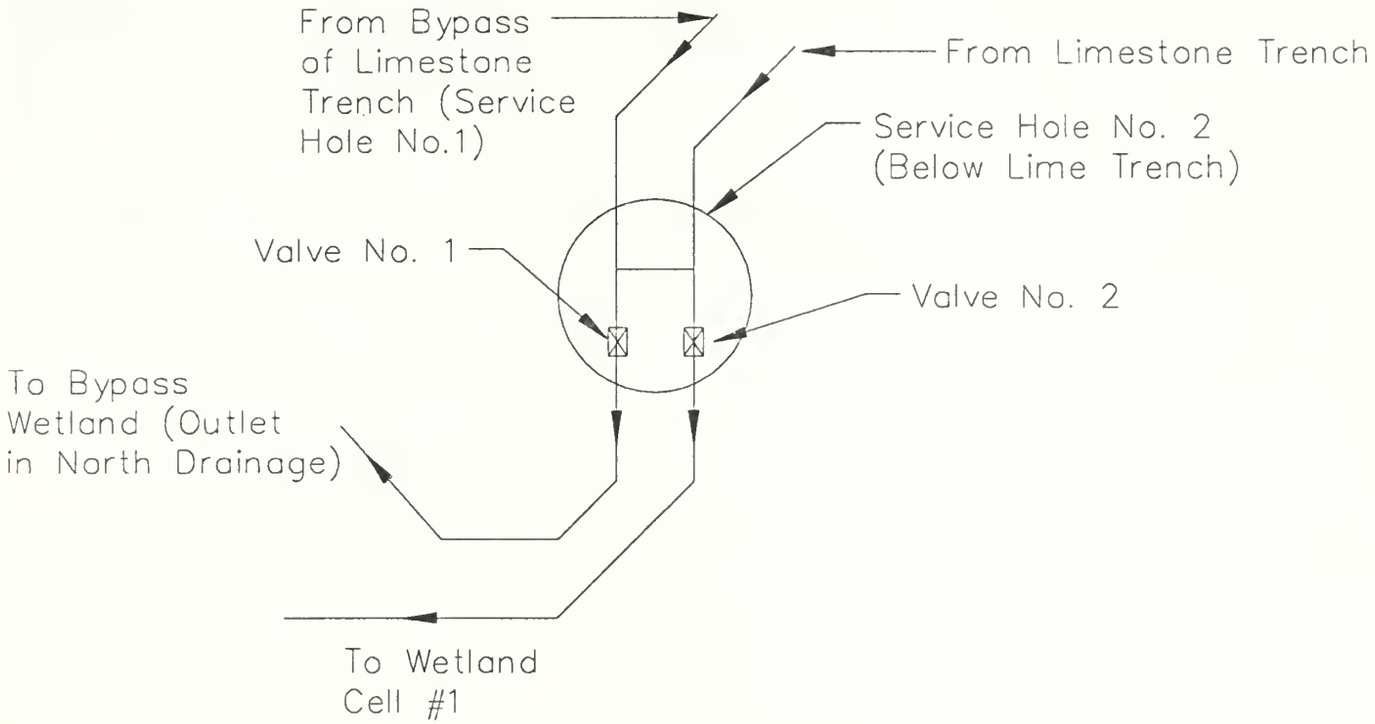
Service hole No.2 also has two inflow pipes and two outflow pipes. Figure 2-O&M depicts the installed system. One inflow, as described above, is from the collector basin or bypass of the limestone trench. The other inflow is from the limestone trench. The service hole outflow pipes are to wetland cell 1 or the bypass of the wetland. The system is designed to have both inflow sources either enter the wetland or bypass the wetland. To properly allow flow into the wetland, valve No.2 needs to be opened then valve No.1 closed. To properly allow flow to bypass the wetland, valve No.1 needs to be opened then valve No.2 closed. If valve No.2 is closed no water will be able to enter the wetland. If both valves No.1 & 2 are closed water will back up the inflow lines. When operating the system, the elbow entering the north drainage from the wetland bypass line should remain in place. This elbow creates an easily cleaned trap which reduces the potential of oxygen moving up the pipeline and causing metals precipitation. The elbow also provides the clearance to obtain a flow measurement.



NOTE:
Not to Scale
All Piping 4"

Robert Peccia & Associates Helena, Montana
Limestone Trench Piping System Schematic
Centerville "C"

Figure 1–OM


From Bypass of Limestone Trench (Service Hole No.1)
From Limestone Trench
Service Hole No. 2 (Below Lime Trench)
Valve No. 1
Valve No. 2
To Bypass Wetland (Outlet in North Drainage)
To Wetland Cell #1

NOTE:

Not to Scale
All Piping 4"

Robert Peccia & Associates Helena, Montana
Wetland Service Hole Piping System Schematic
Centerville "C"

Figure 2-OM

The options at the wetland cells are similar. Each cell has the option of surface or subsurface flow. To place cells 1 and 3 in the subsurface flow option, all that needs to be done is to make sure that the riser pipe located in each cell has its threaded end cap screwed on securely. To place cell 2 in the subsurface flow option, the riser pipe end cap has to be on. Additionally for cell 2, the expanding plug in the outlet pipe of the weir structure between cell 1 and cell 2 has to be moved to the surface flow outlet. To place cells 1 and 3 in the surface flow option, all that needs to be done is to unscrew the riser pipe end caps in each cell. For cell 2, there are two surface flow possibilities: 1) to leave the system adjusted as described for subsurface flow and remove the riser pipe end cap in the cell, or 2) move the expanding plug in the weir structure from the surface flow outlet to the subsurface flow outlet. The surface flow inlet to cell 2 has a section of perforated pipe connected to its end. This section of pipe should stay connected to reduce erosion of the wetland cell side slope. If necessary the end cap of the perforated pipe can be easily removed.

There are two flow options built into each wetland cell. Sequencing scenarios suggested for the operations of the wetland cells would be to choose a scenario, try it, determine its effectiveness with sampling and then try other scenarios.

Scenario 1: It is anticipated that the scenario of having the limestone trench turned off, with cell 1 - surface flow, cell 2 - surface flow, and cell 3 - subsurface flow, will yield the best results in early stages of the system life. This scenario should be chosen at the start of wetland operations. The considerable quantity of limestone in the wetland substrate offers a great amount of buffering capacity. Also wetlands have been found to be very effective in their early stages in part due to the high exchange capacity of the newly installed substrate. Use of the limestone trench should be reserved for when the wetland treatment efficiency decreases.

Scenario 2: It is anticipated that the scenario of having the limestone trench turned off, with cell 1 - subsurface flow, cell 2 - surface flow, and cell 3 - subsurface flow, will yield the next best results in early stages of the system life. This scenario should be chosen after Scenario 1. There is some research that indicates lower treatment results when having the first cell in reducing (subsurface) mode. Therefore, this scenario should be monitored closely. The concept of this scenario is that the first cell will behave similarly to the limestone trench, raising the pH, then with the elevated pH, cell 2 will be an effective oxidizing cell. Because the pH decreases with metals oxidation, cell 3 in a subsurface (reducing) mode will again raise the pH before final discharge.

Scenario 3: It is anticipated that the scenario of having the limestone trench turned on, with cell 1 - surface flow, cell 2 - surface flow, and cell 3 - subsurface flow, will yield the best results over the long term. This scenario should not be chosen at the start of wetland operations. As discussed in Scenario 1, use of the limestone trench should be reserved for when the wetland treatment efficiency decreases.

Scenario 4: It will be important to test the scenario of having the limestone trench turned on or off, with cell 1 - subsurface flow, cell 2 - subsurface flow, and cell 3 - subsurface flow. This scenario tests the concept of having the entire system in reducing conditions. As discussed in the above scenarios, the limestone trench should be used judiciously, being reserved until only when needed later in the system life. This scenario should not be chosen at the start of wetland operations.

Scenario 5: It will also be important to test the scenario of having the limestone trench turned on or off, with cell 1 - surface flow, cell 2 - surface flow, and cell 3 - surface flow. This scenario tests the concept of having the entire system in oxidizing conditions. As discussed in the above scenarios, the limestone trench should be used judiciously, being reserved until only when needed later in the system life. This scenario may be necessary during later life of the system as the subsurface flow system may eventually foul with precipitate.

Other scenarios: There are 16 possible combinations of routing the flow involving the limestone trench and the three cells. The 5 scenarios described above are options which should be tried. The other possible combinations can be tried as time permits. The overall objective would be to maximize system treatment life by keeping treatment effectiveness at the minimum considered allowable. This objective is mentioned because the more effective the treatment, the shorter the system life due to increased precipitate filling of available volume in the wetland. A minimum goal of treatment effectiveness could be water quality useable for livestock. The very minimum treatment goal would be an improvement of system effluent water compared to influent water. Please refer to the appendix to this O&M Plan (Attachment F) for information on suggested water quality goals.

Sufficient information to determine scenario effectiveness would be available in a sampling time frame related to water residence time in the wetlands and should incorporate seasonal variations. In other words, if it is possible each scenario should be operated for a one year period, and at the least as long as the residence time of the water in the entire system.

Water entering the **stock tank** at the outlet of cell 3 is turned on by closing the valve which is located in a nearby valve housing. If necessary the tank can be drained by unscrewing the 2 inch PVC gooseneck in the tank. To fill the tank this gooseneck must be screwed back in place. Please refer to Figure 3-O&M. Opening the stock tank valve will allow water to bypass the stock tank and flow directly to the north drainage.

B. Stockett SE Interceptor drains at the Stockett site are similar to those at Centerville. Water which travels to the north east service hole and the north wetland channel originates from 4 main interceptor drain lines. One from the southeast coulee, a second from the east facing hill, a third from the upper slope of the northwest facing hill, and a fourth from the lower slope of the northwest facing hill. The interceptor line from the lower slope of the northwest facing hill has 2 spur short lines. These 4 interceptor lines are joined about 140 feet up gradient of the northeast service hole. Water sampling done during the construction period identified higher dissolved oxygen (DO) concentrations in the east hill interceptor and the lower slope northwest interceptor. Therefore, at the joining location similar water types were combined. The 2 water sources with lower DO, from the southeast coulee and the upper northwest slope, were joined with the option to enter the limestone trench. The 2 higher DO water sources were joined and bypass the limestone trench.

The **northeast service hole** has two inflow pipes and two outflow pipes. Figure 4-O&M depicts the installed system, which is very similar to service hole No.1 at Centerville. The inflows, as described above, are from the high and low DO interceptor sources. The service hole outflow pipes are to the limestone trench or the limestone trench bypass. The water from the high DO source can only flow directly to bypass the limestone trench. Only water from the low DO interceptor drain source can be routed to the limestone trench. The low DO water from the interceptors has two options in this service hole: 1) into the limestone trench or 2) to bypass the limestone trench. To properly allow flow into the limestone trench, valve No.2 needs to be opened then valve No.1 closed. To properly allow flow to bypass the limestone trench, valve No.1 needs to be opened then valve No.2 closed. The limestone trench bypass and outlet to the wetland channel will have water flowing from the high DO source in all cases. Only water from the low DO source is able to be routed to the limestone trench. If valve No.2 is closed, no water will be able to enter the limestone trench. If both valves No.1 & 2 are closed water will back up the low DO source input line.

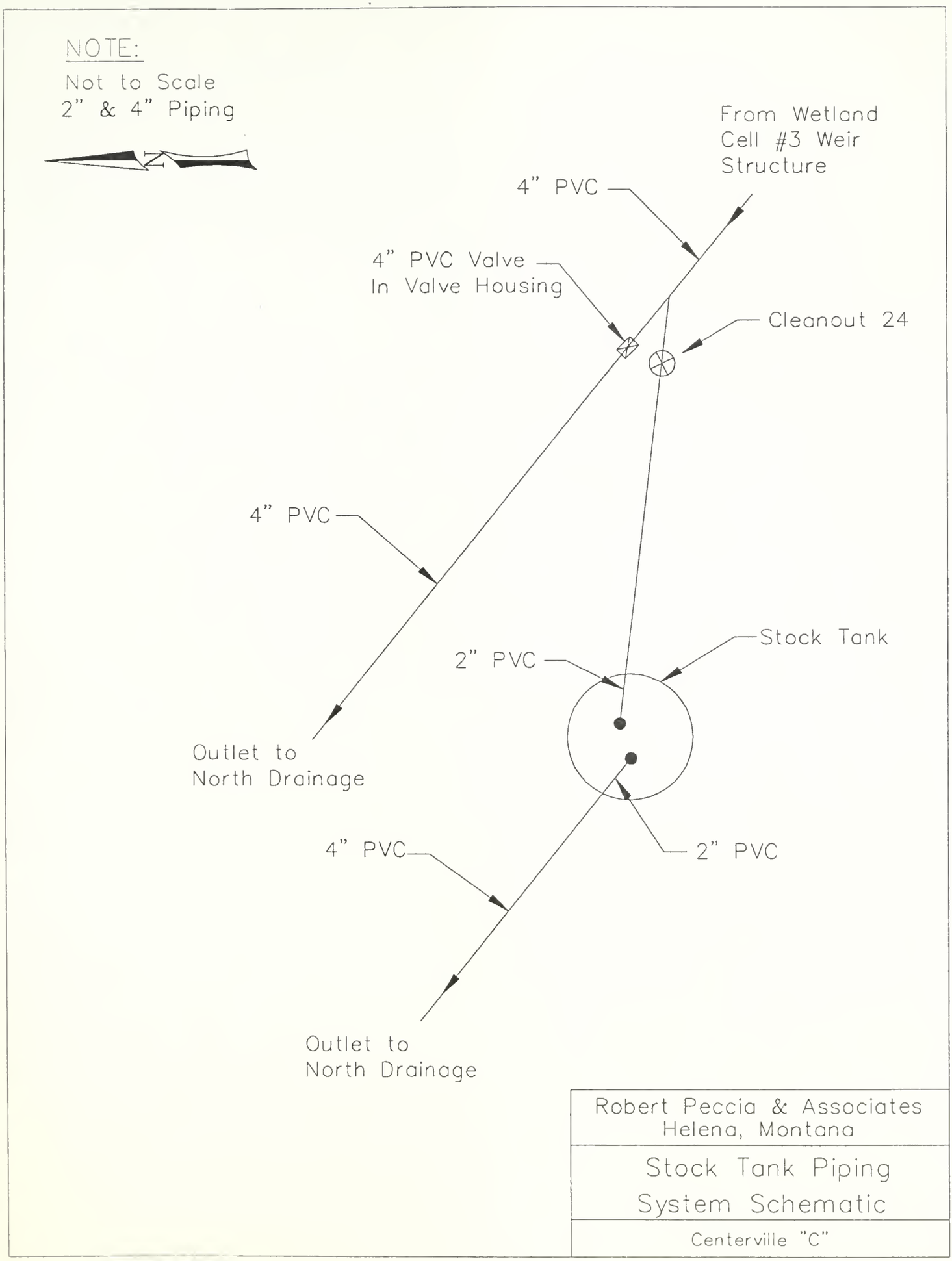

NOTE:
Not to Scale
2" & 4" Piping
From Wetland
Cell #3 Weir
Structure
4" PVC
4" PVC Valve
In Valve Housing
Cleanout 24
4" PVC
Stock Tank
2" PVC
Outlet to
North Drainage
4" PVC
2" PVC
Outlet to
North Drainage
Robert Peccia & Associates
Helena, Montana
Stock Tank Piping
System Schematic
Centerville "C"

Figure 3-OM

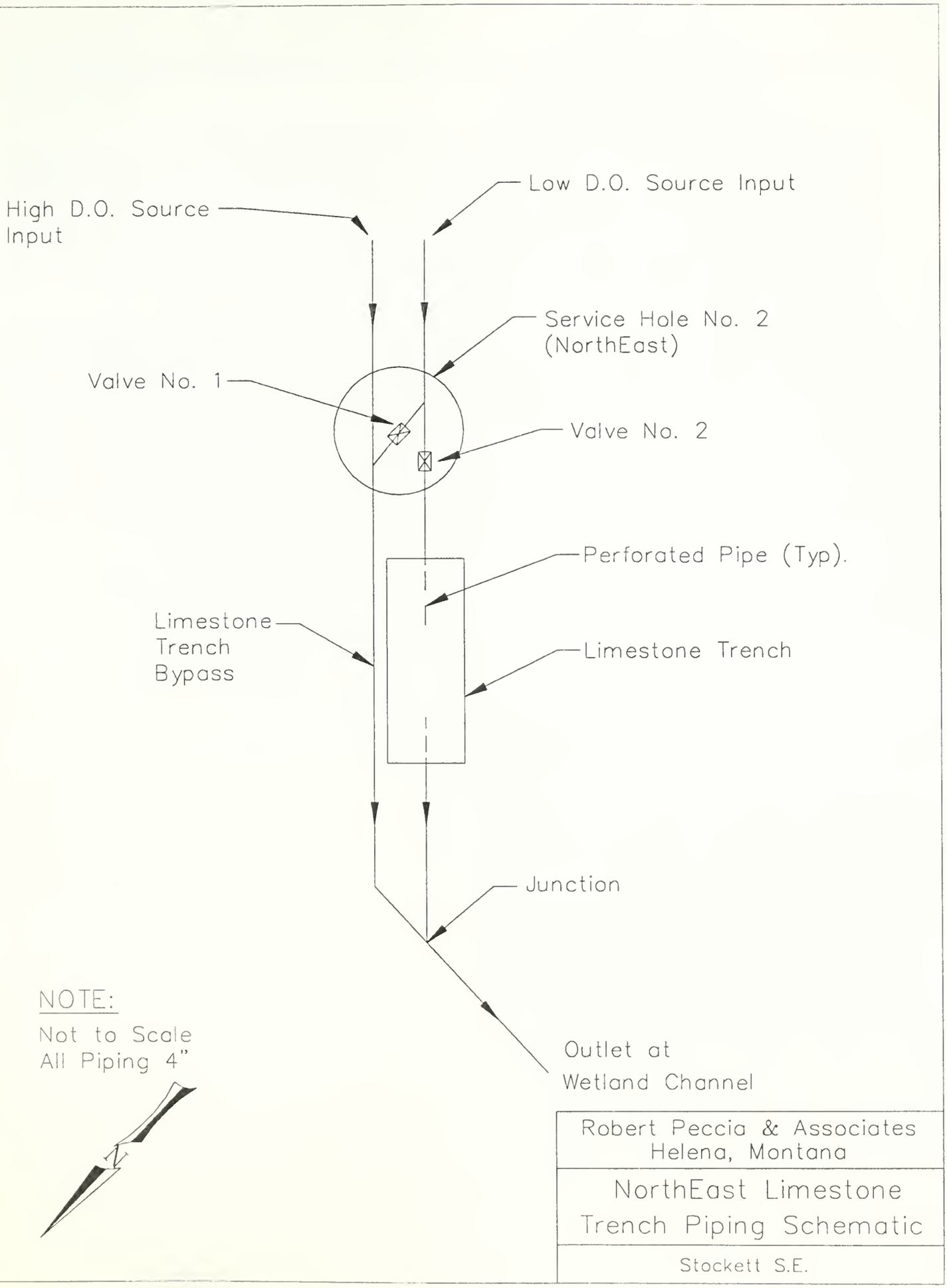

High D.O. Source Input
Low D.O. Source Input
Service Hole No. 2 (NorthEast)
Valve No. 1
Valve No. 2
Perforated Pipe (Typ).
Limestone Trench Bypass
Limestone Trench
Junction
NOTE:
Not to Scale
All Piping 4"
Outlet at Wetland Channel
Robert Peccia & Associates
Helena, Montana
NorthEast Limestone Trench Piping Schematic
Stockett S.E.

Figure 4-OM

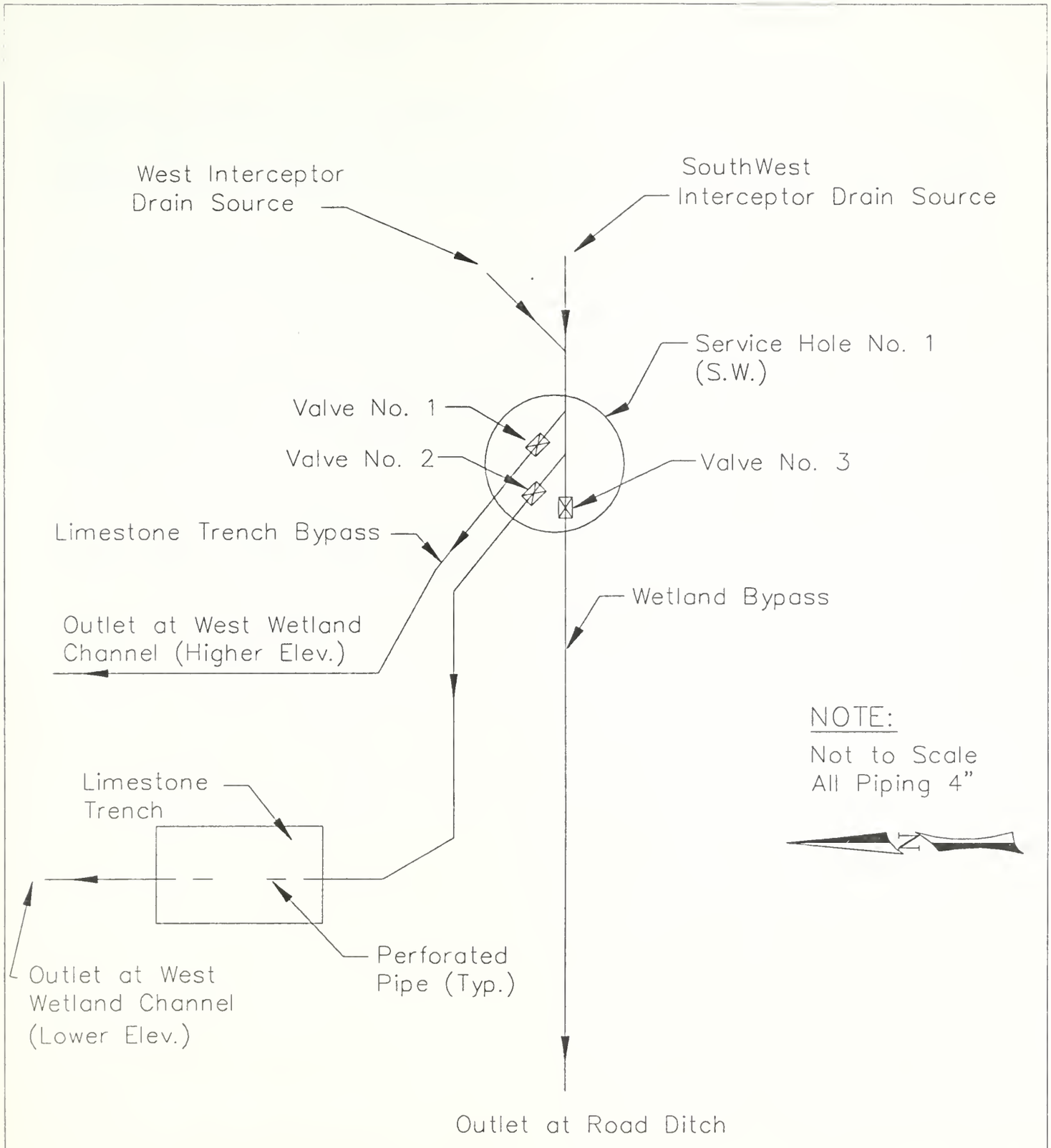
Low on the west slope of the Stockett site, a short interceptor drain system is located near a telephone line. This "**telephone pole interceptor**" does not have any flow control valving and enters directly into the north wetland channel.

The waters entering the **north wetland channel**, from the northeast interceptor system and the telephone interceptor system, can be routed to bypass the channel through a temporary bypass pipe. This bypass is a 2 inch black PE pipe which lays on ground surface adjacent to the wetland channel. To connect this bypass, first remove the elbows on the two inflow pipes, then connect the 4X2 inch adapters. This task will require a screwdriver. When returning the system to normal, allowing flow to the wetland channel, the elbows should be replaced. These elbows create an easily cleaned trap which reduces the potential of oxygen moving up the pipelines and causing precipitation.

The **southwest service hole** has one inflow pipe and three outflow pipes. Figure 5-O&M depicts the installed system. The inflow is from 3 main interceptor sources (refer to record drawings). The three service hole outflow pipes are: 1) to the limestone trench, 2) to the bypass of the limestone trench and enter the west wetland channel or, 3) to bypass both the limestone trench and west wetland channel and enter the road side ditch. To properly allow flow into the limestone trench, valve No.2 needs to be opened then valve No.1 and No.3 closed. To properly allow flow to bypass the limestone trench and enter the wetland channel, valve No.1 needs to be opened then valve No.2 and No.3 closed. To properly allow flow to bypass the limestone trench and the wetland channel, valve No.3 needs to be opened then valve No.1 and No.2 closed. If valve No.2 is closed no water will be able to enter the limestone trench. If valves No.1, 2 and 3 are closed water will back up the source input line.

The waters entering the **west wetland channel** are from either the limestone trench or from the bypass of the limestone trench. The bypass line enters the wetland channel at a higher elevation than the line from the limestone trench. When operating the system to allow flow to the wetland channel and bypass the limestone trench, two things should be done: 1) the elbow should be placed on the bypass outlet and 2) the end cap should be placed on the limestone trench outlet. The elbow creates an easily cleaned trap which reduces the potential of oxygen moving up the pipelines and causing metals precipitation. The end cap will reduce the chance of material entering the limestone trench from the wetland channel and plugging the line.

As with the Centerville wetland, the limestone trenches at Stockett should be used judiciously. Both of the two wetland channel systems should be operated by bypassing the limestone trenches as long as possible while achieving treatment goals. Again, there is a considerable amount of buffering capacity in the installed wetland substrate. This is simply replaced, while the limestone trenches, when no longer effective, will require a considerable amount of earthwork and effort to renew them. This operating philosophy will lower the maintenance required of the system.



Robert Peccia & Associates Helena, Montana
SouthWest Limestone Trench Piping Schematic
Stockett S.E.

Figure 5-OM

3. SUGGESTED MAINTENANCE

Restricted flow is likely to occur in the piping systems installed. With this in mind, the amount of piping was minimized during design and construction to that necessary to control flow and attempt to keep water in anoxic conditions. High concentrations of iron and aluminum are present in the AMD water. Metals precipitation and formation of bacterial slime are primary concerns in pipe fouling. The following information outlines suggested maintenance for each of the primary AMD flow systems installed.

A. Interceptor Drains The interceptor drains installed at both the Centerville and Stockett sites are built to provide cleaning through the installed pipe cleanout assemblies. A pipe wrench is required to remove the threaded end caps. The cleanouts are spaced approximately 100 feet apart. In most cases, cleanouts provide access in a down gradient direction. All piping fittings were installed utilizing 45° angles or less. This accommodates most common pipe cleaning equipment. Suggested pipe cleaning equipment includes a sewer snake or sewer jet. The equipment chosen should not be capable of tearing the perforated pipe. A stiff wire spiral "bird nest or egg beater" head of a sewer snake was used successfully during construction. This head had the end wire bent into the spiral so that it would not catch the perforated pipe. Sewer jet equipment was also used satisfactorily during construction. One advantage of the sewer jet over the sewer snake is that the water jet may clear the perforations in the pipe of precipitate.

Interceptor drain piping should be cleaned and checked for plugging before the end of the one year warranty period. If plugging is found and is unable to be resolved with above ground cleaning, excavation and repair may be required. Plugging found during construction was found to be caused by perforated pipe which collapsed due to improper backfilling. A suggestion for interceptor cleaning is to increase the time between cleaning until an optimum interval can be determined. An example would be 2 cleanings/year for years 1 and 2, 1 cleaning/year for years 3 & 4, and 1 cleaning every other year for years 5 & 6 until an acceptable interval is determined.

An important identifier of a blocked interceptor drain is water leaking out of a cleanout. The blockage would be down-gradient of the cleanout. Access for pipe cleaning can be gained either from the cleanouts or from the pipe outlets into the wetland channels or road ditch at Stockett, or the pipe outlets into the north drainage at Centerville.

B. Collector Basin The collector basin at Centerville should be closely watched for sediment build up. This will be most important during spring and summer runoff events, especially until up-gradient vegetation becomes established. Sediment should not be allowed to flow into the piping network.

The method utilized to clean sediment out of the basin during construction involved a portable pump, two laborers with shovels, a dump truck and a backhoe. An alternative method would be a septic tank vacuum truck. Care should be taken not to tear the liner material of the basin.

C. Limestone trenches The limestone trenches at both sites should be routinely checked for plugging. This can easily be done by checking flows during quarterly sampling of the AMD. While sampling, water quantities should be measured and careful consideration should be given to the operation of the valves.

If flow measurements identify a problem, there are four probable reasons for a difference in flow emanating from the outlet of a limestone trench: 1) valves were turned to correctly allow flow only in bypass mode and to not allow flow in limestone trench (LT) operation mode; 2) insufficient time has been allowed for the LT to fill; 3) there is a blockage in the system between the service hole and the LT outlet line; or 4) there is a leakage in the system between the service hole and the LT outlet line. One should remember that some water will always be bypassing the limestone trench at the northeast limestone trench at Stockett and at the Centerville limestone trench.

Even if a trench is full of water, upon directing the flow to the trench it will take some time for the head to build up allowing water to flow out the outlet pipe. This time is estimated to be less than one hour

assuming no significant blockage in the system. If there is a flow restricting blockage in the system, there would be more time required to build the head high enough to force the water past the blockage.

Sources of blockage or leakage could include the following: 1) precipitate or other material blockage in the limestone trench, PVC pipe, or the perforated pipe inlet or outlet of the limestone trench; 2) broken or collapsed piping, or 3) loss of liner integrity. Loss of liner integrity is unlikely because of the double liner system installed. The most vulnerable locations of the limestone trench line are at the inlet and outlet connections. The two short runs of piping, from the service hole valves to the limestone trench and from the limestone trench to the outlets or down-gradient cleanouts, would be suspect because they were not tested after installation.

Recommendations to more definitely determine the reason for a problem with a limestone trench would be to: 1) review the valve adjustments in conjunction with conducting an additional round of sampling; 2) measure and observe flow entering the limestone trench by taking apart valve No.1 (applicable to all service holes up-gradient of limestone trenches); and 3) test in conjunction with cleanout of suspect piping. Testing or cleanout of limestone trench piping can be accomplished by accessing the pipe from the service holes or pipe outlet end. In the service holes, this requires taking the valves and/or couplings apart.

Longevity and the potential for replacement of the limestone trenches is discussed later in this Operations and Maintenance Plan.

D. Centerville Wetland The Centerville wetland should be routinely checked for fouling of the weir structures. This can easily be done during quarterly sampling of the AMD. While sampling, water quantities should be measured and careful consideration should be given to the water balance for the wetland system. The most probable fouling problems would occur in fall and winter due to dead vegetation and ice.

If a weir structure is plugged, it can easily be cleaned with a shovel after removing the wood lid. If a substantial amount of plugging is occurring, the system should be switched to the surface flow option to reduce the potential of fouling the subsurface flow system. If the subsurface flow system is plugged, the subsurface perforated pipes can be cleaned using the same methods described for interceptors. Access for snaking or jetting is from the weir structures entering cell 2 and 3. To clean the perforated pipe in cell 1 access is from service hole No.2. If it ever becomes necessary to drain a wetland cell, a pump can be placed in the riser to the subsurface drain system.

The overflow ditch behind each weir structure is in place for emergency conditions only and not for long term operation. If this overflow needs cleaning, switch to the surface flow option, and/or operate to bypass the wetland until cleaning is completed.

If flow short circuiting is suspected in the wetland system, a number of options exist for determining actual residence time of the water in the wetland. One method which has been used successfully is a tracer test utilizing a bromide tracer.

Longevity and the potential for replacement of the wetland system is discussed later in this Operations and Maintenance Plan.

E. Wetland Channels The wetland channels at Stockett should be watched closely for precipitate, sediment and ice build up. The two wetland channels should be visually inspected during each quarterly sampling of the AMD. If problems are identified, the system can be switched to the wetland bypass option. Cleaning methods would be similar to those described for the surface water collection basin at Centerville. If necessary, the height of the wetland channel dams can be adjusted by rearranging the rip rap and baffles by hand.

F. Stock Tank Use of the stock tank should be determined by the effluent water quality of cell 3 as well as the landowners need. If the landowner, Otto "Gene" Johnson, does not have livestock in the area there

will be no need for the water to be routed to the tank. If water quality does not meet livestock drinking standards the water should not be routed to the tank. Correspondence with the landowner should take place to ascertain his intended periods of water need. The checking of water quality should correspond to this use. A copy of recommended livestock drinking water standards are included in the appendix to this O&M Plan (Attachment F). If necessary the piping at this area can also be cleaned. One restriction is that the pipe entering the stock tank is 2 inch PVC.

4. SUGGESTED SAMPLING

Wetlands and limestone trenches have been found to be effective in amelioration of AMD problems but numerous questions remain as to how these controls work in AMD treatment. Several physical, chemical and biological processes contribute to the chemical changes in AMD as it flows through a wetland. Some of these processes may include dilution, oxidation and hydrolysis, sulfate reduction, plant metabolism, adsorption, chelation, ion exchange, sedimentation, filtration, absorption, precipitation and decomposition.

The purpose of this section is to briefly discuss and identify the environmental parameters which could be sampled and analyzed at the constructed wetland sites. To identify the parameters to be analyzed, the goals of the sampling and analysis program need to be defined. These goals would likely include the following.

1. Investigate treatment effectiveness.
2. Investigate treatment longevity.
3. Identify optimum design mechanisms.
4. Obtain statistically valid and reproducible results.
5. Investigate treatment processes to determine essential elements.
6. Outline recommendations for future designs.

In the following discussion suggested sampling parameters which can be considered optional are noted as such. Not sampling for the optional parameters would reduce analysis costs; however, sampling of the optional parameters should be seriously considered throughout the sampling history of the project.

A. Field Parameters

Field parameters suggested for analysis include pH, Electrical conductivity (EC), dissolved oxygen (DO), oxidization-reduction potential (Eh), temperature and flow. All of these parameters would have an effect on all the project goals listed above. Additional field parameters suggested include vegetation mapping and photographic documentation of the wetland. Each field visit should be recorded. The record should include all operation and maintenance actions as well as any additional observations on the project sites.

The pH, the negative log of the hydrogen ion concentration, is a simplified measurement of the acidity or alkalinity of the water. It is easily obtainable and is a readily identifiable measurement in the scientific community. The pH in conjunction with the Eh can give the reviewer an idea of the theoretical metal complexes in the system sampled.

The EC indicates the relative ease with which a water based solution will carry electricity. It is measured to give the reviewer an idea of the number of ions in the solution and aids in verification of the total chemical content of the solution.

Dissolved oxygen levels in natural and wastewaters depend on the physical, chemical, and biochemical activities in the water body. The analysis for DO is a key test in water pollution and waste treatment process control. The amount of DO in water is a function of the water's temperature (colder water contains more DO) and salinity (more saline waters contain less DO). Temperature changes as well as chemical and biological activities all use or release oxygen, causing the amount of DO in water to change continually. This in turn affects impacts to any receiving water bodies, i.e. limestone trenches. A high DO in conjunction

with a high iron content will likely cause oxidation and precipitation, especially in an elevated pH situation. This should be avoided in limestone trenches and subsurface wetland flows.

Oxidation-reduction (optional) ORP or "redox" reactions play a central role in many of the reactions occurring in natural waters and in water and wastewater treatment processes. The behavior of compounds containing carbon, nitrogen, sulfur, iron, and manganese is largely influenced by redox reactions. The biochemical oxygen demand (BOD) and the chemical oxygen demand (COD) tests and the analysis of dissolved oxygen are based on redox reactions. Microbially mediated redox reactions are significant in transformations of nutrients, metals, and other chemical species in water. The fate of materials introduced into the environment frequently depends on the redox environment to which they are subjected. An understanding of oxidation-reduction equilibria can help to indicate whether a particular reaction is possible under given environmental conditions and this understanding is helpful in evaluating how conditions might best be altered to encourage desirable transformations or to prevent undesirable ones.

Temperature has an effect on the chemical and biological reaction rates and will help delineate seasonal fluctuations. Flow is necessary to determine a water mass balance in the treatment system and the loading rate on the system. Flow measurements will also help delineate seasonal fluctuations. Flow from outlet pipes should be taken using the bucket and stopwatch method. Flow into the weir structures should be taken by measuring the head of water above the apex of the 90° weir plate notch. See the table in the appendix to this O&M Plan (Attachment F) for the conversion to gpm.

Vegetation mapping and photographic documentation (optional) will aid in determination of treatment effectiveness in the potentially different vegetation types and densities. The water depth and chemistry and possibly substrate type will have an effect on vegetation type. The environment which fosters a certain vegetation establishment may also be beneficial to water treatment. If this is known, future designs can implement similar environmental conditions.

B. Substrate Parameters (optional)

Proposed substrate sampling parameters include sorbed and solid fractions of Al, Fe, Mn, and Zn as well as microbial populations, buffering capacity and cation exchange capacity (CEC). The substrate metals analysis would give a reviewer an idea of the quantity and types of metals collecting in the wetland. Substrate samples should be taken from at least three location in each wetland cell to determine if the sampling would be statistically valid. Substrate sampling suggestions for the large cell 2 would be to obtain at least 6 samples, 3 from the south half and 3 from the north half. A common sampling depth of 1 foot is suggested. Substrate sampling done only in the center may or may not be indicative of the substrate as a whole. If preferential flow occurs in other than the center of the cell, one may want to increase the number of locations or vary the sampling location to account for this.

Healthy microbial populations, specifically iron or sulfate reducing bacteria, are thought to play a large part in wetland treatment efficiency. Some analysis methods which should be considered for our situation include: Direct Total Microbial Count, Stressed Organisms, and Identification of Iron and Sulfur Bacteria. The ultimate goal of these analyses would be to identify the optimum designed environment for the beneficial microbes and to use these findings to improve future or existing treatment designs.

Buffering capacity and CEC are important for a number of reasons. Because the microbial population effect on wetland water treatment is thought to be easily influenced by temperature, the other components of the wetland treatment need to be viable during the cold periods. Current thinking is that the mineral buffering capacity will not only "pick up the slack" during colder and slower microbial growth periods but also fosters an environment more conducive to microbial growth during all periods. CEC is also likely to be more important during colder time periods since its effect on metal removal from the AMD should be less effected by temperature changes. How long and under what conditions CEC and buffering capacity are effective in AMD treatment may be determined by the analysis of CEC and buffering capacity. These data may also add to the understanding of overall wetland effectiveness and longevity. If it is determined that these parameters are indeed crucial to wetland performance in the long term, it will behoove us to investigate and

design methods to increase their concentrations. Other than incremental mechanical additions of lime or carbon to increase buffering capacity or CEC it would be preferred that the systems generate the required components from sources input to the original wetland.

C. Water Parameters

The Influent/Effluent and substrate pore water parameters suggested for analysis is where the most sampling questions arise. These can include acidity, alkalinity, aluminum (Al), iron (Fe), manganese (Mn), zinc (Zn), calcium (Ca), magnesium (Mg), sulfate (SO_4), total organic carbon (TOC), total kjeldahl nitrogen (TKN), nitrate nitrogen (NO_3^-), total dissolved solids (TDS), total suspended solids (TSS), biochemical oxygen demand (BOD), and chemical oxygen demand (COD). Pore water sampling is an optional sampling recommendation. If pore water sampling is conducted, frequencies and locations similar to substrate sampling are suggested. The method suggested for pore water sampling includes use of a portable peristolic pump and lysimeters.

In AMD, mineral acidity is largely a result of water contact with metal salts, particularly involving the trivalent metal ions such as Fe^{3+} and Al^{3+}. A current method to determine optimum wetland size utilizes influent alkalinity and acidity.

Common constituents in AMD include Al, Fe, Mn, Zn, Ca, Mg, and SO_4 and the determination of net change between influent and effluent water concentrations will be used as a means to determine treatment effectiveness. Both ferrous (Fe^{2+}) and ferric (Fe^{3+}) iron should be analyzed in the water entering the limestone trenches or ALD's. This valence state ratio relates to the DO and ORP and research recommendations are to have no Fe^{3+} entering an ALD or iron precipitation may result.

The measurement of TOC (optional) can be used as a means of determining the relative importance of organic carbon in AMD treatment. In general TOC has two fractions, dissolved and particulate, which are delineated by the size capability to pass a 45 µm filter. The TOC typically consists of the following constituents in order of decreasing size: zooplankton, phytoplankton, bacteria, (45µm boundary), clay-humic-metal complexes, viruses, humic acid, fulvic acid, hydrophilic acids, fatty acids, carbohydrates, amino acids, and hydrocarbons. As the roll of organic carbon constituents is considered to be important in wetland treatment methods, a quantification of the carbon is also important. The concentration of TOC is likely affected by the use of different substrate types, vegetation types and densities, water depth, and sampling location in relation to inflow of highly mineralized, acidic water. If the correlation of TOC to treatment efficiency is found to be significant, then the design of the treatment system can be changed to enhance this condition. Having an idea of organic carbon content in the wetland will also yield information on the wetland as to whether it is functioning properly when compared to typical TOC information available on naturally occurring systems. In future sampling programs, TOC may be further divided into its typical size fractions or constituents to define the most important constituents.

The TKN (optional) analysis will include both the ammonia(NH_3)-Nitrogen and organic-Nitrogen content of the water. The NO_3-nitrogen analysis will determine what is typically considered to be plant and microbe available. These analyses will give a basic understanding of the nitrogen cycle in the location sampled. Typically, denitrification is dominant in reduced wetland conditions but many nitrogen fixers are available in reduced wetland systems including blue-green algae and some anaerobic bacteria. Typha also introduce oxygen to reduced substrates through root-sediment interfaces and support nitrogen fixing microbes in the rizosphere. Nitrogen is often a plant growth limiting factor in nature and may be a limiting factor for sulfate reducing bacteria. For our reducing wetland systems, the goal is to foster the best environment possible for these sulfate reducing bacteria. Nitrogen would be an important addition to substrate if it is determined that nitrogen in the existing systems is limiting and system designs that foster environments of more available nitrogen should be considered.

Total solids, the material residue remaining from drying water, is made up of TSS, that portion of total solids retained on a 45 µm filter and TDS, the portion that passes through the filter. The TDS mainly consists of carbonates, bicarbonates, chloride, sulfate, calcium, magnesium, sodium, and potassium. In most

waters, dissolved metals and dissolved organics account for a small portion of the TDS, but in highly mineralized AMD in wetland systems this is likely to be a much larger portion. Another application of TDS is a check on the quantity of the water constituents (total quantity of dissolved solids, carbonates, metals etc. = TDS).

The TSS is usually made up of larger organics similar to those accounting for the constituents making up particulate organic carbon. Knowing the TSS, we can compare this to the TOC portion and improve our understanding of the effects of the different size organics in metals removal. TSS is commonly used as a means of determining effectiveness of water treatment systems. The removal of suspended solids from wastewaters is important for surface water pollution control. This measurement will be especially important in phases of startup or changing wetland treatment methods, such as changing from subsurface to surface flow, as these would likely be the times of highest TSS loading on a receiving water body. If the levels of TSS are excessive during different treatment time frames then when a receiving water body is potentially at risk the system design can be adjusted to reduce this input. If TSS concentrations are not found to be a detriment to receiving waters then we may be able to drop this sampling parameter for this project and possibly for sites with similar design characteristics.

The BOD (optional) test measures the oxygen utilized during a specified incubation period for the biochemical degradation of organic material (carbonaceous demand) and the oxygen used to oxidize inorganic material such as sulfides and ferrous iron. The COD (optional) measures the oxygen equivalent of the organic matter content of a sample that is susceptible to oxidation by a strong chemical oxidant. For samples from the same source, COD can be correlated to BOD, organic carbon or organic matter. After the relationship between COD and these other organics related constituents is established then COD alone can be measured at a lower cost. Both COD and BOD tests are widely used to determine the pollution strength of wastewaters in terms of the oxygen that will be required if they are discharged into natural water bodies in which aerobic conditions exist. The BOD test is very important in regulatory work and evaluation of the purification capabilities of receiving water bodies. The main limitation of the COD test is its inability to differentiate between biologically oxidizable and biologically inert organic matter. Because the BOD is designed to determine the biologically oxidizable organic matter, and because COD is not affected by toxicity of the environment, COD is often much larger in value than BOD. By determining BOD/COD we may find certain portions of the wetland water treatment systems have more or less oxygen demand and by comparing this to other parameters an optimum demand on the system may be determined. Should the systems have an unacceptable oxygen demand on receiving waters the current and future wetland treatment designs could be revised.

D. Sampling Frequency

Field and Influent/Effluent should be sampled as follows: Year 1 @ 1 sample/2 months, Year 2 @ 1 sample/quarter year (seasonal) plus one floating sample period for the high flow period of the year. The floating sample round could be eliminated if the spring sample corresponds to the high precipitation period of the year. The fall quarterly sample should correspond to the low flow period of the year.

Substrate and Substrate Pore Water - Year 1 @ 2 samples/year, Year 2 @ 1 sample/year.

This suggested sampling regime should be adjusted as the goals and objectives are further defined and as results of other wetland sampling programs are compiled. Unless adjusted by changing goals the year 2 sampling frequency should be continued for a period of 10 years, then re-evaluated.

E. Sampling Methods

Sampling methods should follow a consistent and standard operating procedure which is statistically valid. Basic concepts of a chain of custody, decontamination, duplicates, sample preservation, sample date, sample location, mode of system operation for current sample and sample shipping should be followed. The following table outlines some of the basic sampling requirements. AMRB should also set up a standard operating plan and maintain a data base to compile the analysis results.

CURRENT REQUIREMENTS (NOVEMBER, 1991) FOR WATER SAMPLING[1]

PARAMETER	FILTERED/ UNFILTERED[2]	CONTAINER VOLUME & TYPE[3]	PRESERVATIVE[4]	NOTES[5]
Field Analyzed	N/A	N/A	N/A	Field[6]
Metals (Fe included)	F/U	250 ml	1+1 HNO_3 - 2 ml vial	6 Mo.Max. Holding Time
Metals (Fe^{2+})	F/U	120 ml	Conc. HCL - 3 ml vial	No air in bottle. Analyzed within 48 Hrs.
Acidity, Alkalinity, TSS, TDS, Ca, Mg	U	500 ml	None	Analyzed within 14 Days
BOD	U	500 ml	None	Analyzed within 48 Hrs.
TOC, TKN,NO_3, COD	U	500 ml	1+5 H_2SO_4 - 2 ml vial	28 Day Max. Holding Time

[1] References: Standard Methods for Examination of Water and Wastewater, Seventeenth Edition; Energy Laboratories, Billings, MT (EPA Certified Lab).
[2] Filtered with 45 micron filter = Dissolved result; Unfiltered = Total result.
[3] Containers may be plastic or glass unless otherwise noted.
[4] The quantity of the preservatives described results in a pH less than 2 in the container described. If filtering, filter prior to preserving.
[5] Samples should be sent to Laboratory as soon as possible, kept cool at or below 4°C, and a parameter list should accompany the samples.
[6] Field parameters (pH,EC), if sent to the Lab, should be analyzed within 48 hrs.

F. Sampling Locations

It is important to have the samples taken in a similar manner and location during each sampling round. If this is not done, data results may be effected by differing sampling methods and the interpretation of data will be unreliable. Following is an outline of the recommended influent/effluent water sampling locations and the order they should be taken.

1. Centerville (abbreviate as CC on sample labels)

a. With flow to the wetland turned on. Record if limestone trench (LT) is on or off. Also record what flow option is being operated for each cell (surface or subsurface). Sample:

1. In the cell 3 weir structure (cell 3 out)
2. In the cell 2 weir structure (cell 2 out)
3. In the cell 1 weir structure (cell 1 out)
4. In the weir structure of the surface water collection basin (CB out)

b. With flow to the wetland bypassed (BP). Record if the limestone trench is turned on or off. Sample:

5. At the outlet of the wetland bypass at the north drainage. (wet BP, LT on/off)

c. With flow to the wetland bypassed. Turn the limestone trench opposite to when sampled in B. Record if the limestone trench is turned on or off. Sample:

6. At the outlet of the wetland bypass at the north drainage. (wet BP, LT on/off)

d. (Optional) With flow to the wetland bypassed. Turn the limestone trench off. Stop flow from the surface water collector basin (CB). Sample:

7. At the outlet of the wetland bypass at the north drainage. (wet BP, LT on/off, CB off)

When changing flow directions for sampling scenarios c and d above, allow adequate time to have the representative water reach the sampling location. This time should be at least one hour. Residence time in the limestone trench is roughly estimated at 2 days (ie: the LT should run a minimum of 2 days for a representative sample).

2. Stockett (abbreviate as SSE on sample labels)

a. West wetland channel (WCHNL). With flow to the wetland turned on. Record if limestone trench is on or off. Sample:

1. At the channel outlet down gradient of the last channel dam. (WCHNL out)
2. At the applicable inlet pipe to the wetland channel (outlet of the limestone trench or outlet of the trench bypass). (WCHNL in, LT on/off)

b. West wetland channel. With flow to the wetland turned on. Turn the limestone trench opposite to when sampled in A. Record if limestone trench is on or off. Sample:

3. At the applicable inlet pipe to the wetland channel (outlet of the limestone trench or outlet of the trench bypass). (WCHNL in, LT on/off)

c. North wetland channel (NCHNL). With flow to the wetland turned on. Record if limestone trench is on or off. Sample:

4. At the channel outlet down gradient of the last channel dam. (NCHNL out)
5. At the inlet pipe to the wetland channel. (NCHNL in, LT on/off)

d. North wetland channel. With flow to the wetland turned on. Turn the limestone trench opposite to when sampled in C. Record if limestone trench is on or off. Sample:

6. At the inlet pipe to the wetland channel. (NCHNL in, LT on/off)

e. (Optional) North Wetland channel. With flow to the wetland turned on. Turn the limestone trench off. Take the NE service hole valve No.1 apart. Sample:

7. At the inlet pipe to the wetland channel (this will be the high dissolved water (DO) water source only). (NCHNL in, hi DO)
8. At the NE service hole valve No.1 (this will be the low DO water source only, prior to entering the limestone trench). (NESH, lo DO, in LT)

When changing flow directions for sampling scenarios b and d above, allow adequate time to have the representative water reach the sampling location. This time should be at least one hour. Residence time in the limestone trenches is roughly estimated at 2 days (ie: the LT's should run a minimum of 2 days for a representative sample).

5. MINE DRAINAGE CHEMICAL PREDICTIONS AND THEORETICAL SYSTEM LONGEVITY

A. General Considerations

The basic components which cause acid mine drainage (AMD) are air (O_2), water (H_2O), pyrite (FeS_2), and iron-oxidizing bacteria (Thiobacillus ferrooxidans). Methods used in this project to exclude air from the process involve control of the water in the piping system. It should be noted that the wetland treatment technology is experimental and does not represent a permanent, maintenance free restoration of AMD.

With the installed controls and proper maintenance, it is possible to keep the intercepted waters in an anoxic state prior to exposure out of the piping control system. Expected chemical changes upon flow through a limestone trench would be an increase in pH and alkalinity. With exposure to air, the metals (primarily iron) will precipitate (oxidation and hydrolysis). The precipitation process generates acidity and acts to decrease pH. A primary reason for a limestone trench is to raise the AMD alkalinity high enough to allow precipitation. Bacterial sulfate reduction (reducing or subsurface flow wetlands) is another method to produce alkalinity. The collected waters are acidic enough that the alkalinity needs to be raised to foster effective precipitation.

Causing AMD to go through the process of oxidation and reduction will decrease metals concentrations in the effluent. In the case of the Centerville wetland, cell 3 is provided to raise the AMD pH through sulfate reduction, after the pH has been reduced through hydrolysis in cell 2. The concept at the Stockett wetland channels is to have a series of reducing and oxidizing cells at each check dam. With time these channels will likely become purely oxidizing channels.

A number of constructed wetland design concepts for treatment of AMD have been developed by key wetland researchers (Brodie, Wildeman, Hedin, Klineman, Wieder, and Hammer). The basic idea is to increase water pH and reduce metal concentrations utilizing physical, chemical, and biological mechanisms such as sedimentation, filtration, adsorption, precipitation, ion exchange, chelation, sulfate reduction, decomposition, microbial oxidation, plant metabolism and absorption. The focus of recent experimental research is that these components can be used in different combinations and in conjunction with other treatment systems to optimize treatment efficiency.

Wetland sizing and type are important design criteria. Current research techniques to determine optimum wetland size and type are based on AMD flow rate, pH, iron concentration, manganese concentration, and dissolved oxygen (D.O.) concentration. Recent research has pointed to integrating AMD acidity and aluminum concentrations into design criteria. Over the past ten years implications of field test results on sizing guidelines have resulted in increased wetland sizes. The standard metal loading rates used are in units of GDM's (grams/day/square meter).

The concept of a limestone trench or anoxic limestone drain (ALD) has evolved out of the need to raise AMD alkalinity to facilitate improved wetland AMD treatment. Passive treatment with ALD's has begun to replace more traditional active lime treatment methods at active mine sites. A primary concern with ALD design is that the AMD must have low oxygen concentrations (D.0. <1.0 to 2.0 mg/l) to reduce the occurrence of iron oxidation and limestone armoring. Another concern is Aluminum (Al) concentrations. Recent recommendations are to try to limit influent Al concentrations to <2 to 25 mg/l. Currently, the recommendations for ALD sizing and longevity are based on acidity loading and limestone calcium carbonate content.

B. Wetland Design

The design of these wetlands to treat acid mine drainage (AMD) is experimental based on state of the art research. Primary objectives of this project are 1) to improve AMD water quality and 2) to be capable of testing different treatment methods for effectiveness and minimal maintenance.

C. Sizing and Life Expectancy

The most widely accepted method of wetland sizing has been based on iron loading rates and aerobic wetland design. More recently, the U.S. Bureau of Mines (BOM) has looked at acidity loading rates as a basis to size wetlands for AMD treatment. BOM experts strongly recommend a sizing design loading rate of 5 to 10 grams of acidity/day/square meter for highly acidic water treatment. To be able to apply the less stringent (higher loading rate) sizing requirement of 10 GDM, the wetland system should include some sulfate reducing cells, 20 to 25% limestone rock mixed in the wetland substrate (compost), and a limestone trench, if possible. All the above ideas are incorporated in the current staged wetland design.

Wetland sizes calculated for the Centerville and Stockett wetlands and shown in Table 1 O&M are based on these recent design guidelines. A comparison of 5 wetland sizing methods are shown on the following table. On this table, it can be seen that the acidity-based sizing requirement results in larger wetlands than the iron-based size. Using the anaerobic or staged wetland types decreases the sizing requirement. The use of an ALD also decreases the wetland sizing requirement. In the appendix to this O&M Plan (Attachment F) there is a table of sampling analysis results.

TABLE 1 O&M. - Comparison of Wetland Sizing Methods

Wetland Type	Input Criteria	Size @ Centerville "C"	Size @ Stockett SE North Wetland Channel	Size @ Stockett SE West Wetland Channel
Aerobic	Iron loading, 2 GDM	1.2 ac.	3.8 ac.	3.5 ac.
Aerobic w/ ALD	Iron and Acidity loading, 5 GDM	2.3 ac.	6.4 ac.	6.3 ac.
Aerobic w/o ALD	Iron and Acidity loading, 5 GDM	2.8 ac.	6.6 ac.	6.5 ac.
Anaerobic (Compost)	Acidity loading, 5 GDM	2.8 ac.	6.5 ac.	6.5 ac.
Staged	Acidity loading, 10 GDM	1.4 ac.	3.3 ac.	3.2 ac.
Current Design Size	Size based on available area	1.0 ac.	0.2 ac.	0.1 ac.

Concerns from the BOM about limestone trenches and potential precipitation of aluminum (Al) have been addressed by allowing flow bypass, including flushing access and positive sealing. These design items should also increase the effective life of the trench. The strict Al concentration guideline is not attainable with the given AMD chemistry; therefore, the previously discussed controls have been built into the system.

The ALDs were sized similarly to the wetlands to be as large as practical while utilizing both the existing piping and head. This resulted in ALD sizes at the Centerville and Stockett Systems of 90 cubic yards for each of the ALDs installed. If we assume a 75% dissolution rate of the limestone, a 90% calcium carbonate content ($CaCO_3$), and a conversion rate of 1.33 tons of limestone/cubic yard, the theoretical longevity of the ALDs are 3.5 years for the Centerville System, 1.5 years for the Stockett SE North System, and 1.5 years for the Stockett SE West System.

These life expectancies are based on a Centerville loading rate of 1733 mg/l acidity at 6 gpm, a Stockett SE North System loading rate of 8073 mg/l at 3 gpm and a Stockett SE West System loading rate of 8020

mg/l at 3 gpm. From the lower Al content in the Centerville AMD, at 218 mg/l, compared to the Stockett sites Al content, at 983-1140 mg/l, we expect the Centerville site water to be less troublesome due to Al clogging. Recent research reveals that the installation of an ALD will decrease acidity by about 300 mg/l. This will reduce the total acidity in the Centerville AMD to 1433 and Stockett AMD will be decreased to about 7773-7720 mg/l. For these reasons the Centerville ALD is expected to enhance treatment more significantly than the Stockett ALDs. The Stockett AMD is acidic enough that the ALD effectiveness will not be as significant but even this small enhancement should improve treatment.

Two of the most often asked questions regarding wetland design and construction are: 1) How long will they last; and 2) What is the likely effluent water chemistry? These are very difficult questions because AMD treatment with wetlands is experimental and long term research data is unavailable. A project done by the Reclamation Research Unit at Montana State University studied a natural wetland (Swamp Gulch near Lincoln) which has received AMD for about 55 years. At the time of the study, the Swamp Gulch wetland was about 70% effective in removing iron. The study findings are consistent with current research in that treatment effectiveness of wetlands have been found to decrease with time. One estimation of wetland life can be made by consideration of available volume for AMD precipitate, treatment effectiveness, and precipitate density. The following Table 2 O&M presents some life expectancy estimates.

TABLE 2 O&M. - Theoretical Wetland Life Expectancy

	Centerville "C" Wetland	Stockett SE North Wetland	Stockett SE West Wetland
Available Volume[1]	3895 CY	340 CY	175 CY
Loading Rate @ 100% efficiency[2]	145.8 lbs./day	357.7 lbs/day	351.3 lbs./day
Life expectancy w/ppt. density of 1.1 grams/cc (topsoil density)	135.7 yrs.	4.8 yrs.	2.5 yrs.
Life expectancy w/ppt. density of 0.5 grams/cc	61.7 yrs.	2.2 yrs.	1.2 yrs.
Life expectancy w/ppt. density of 0.25 grams/cc (organic muck density)	30.8 yrs.	1.1 yrs.	0.6 yrs.

[1] Assumes 30% gravel porosity, 50% peat porosity, maximum W.L. at 1 ft. above design W.L.
[2] Assumes recent concentrations of acidity, iron, and manganese at flows of 6 gpm (Centerville) and 3 gpm each (Stockett SE). See Appendix.

These life expectancies could be considered conservative because the 100% efficiency used will likely be lower with time, resulting in a lower loading rate. The measure of treatment effectiveness can be viewed in a number of ways.

1. Life expectancy could be considered that life for which a certain minimum treatment effectiveness is attained.

2. Design sizing criteria are based on a treatment effectiveness meeting the minimum water discharge criteria for an active mining operation, essentially NPDES or "Gold Book" standards.

3. Another discharge criteria is dependant on the receiving water-body chemistry. This view of our non-degradation policy of state waters has the objective, at a minimum, to maintain water quality to or better than currently exists. For this project the receiving water-body chemistry is the same as the discharging AMD water.

4. Other measures of the degree of water treatment effectiveness could be to improve the water quality for additional uses. Examples of this would be (in order of decreasing treatment effectiveness): a) drinking water, b) aquatic life, c) irrigation water, and d) livestock water (examples of these water quality guides are in the appendix to this O&M Plan.

The expected water quality of the designed systems will be variable. Given the design size of the wetlands, which are maximized for the available area, we have the following expectations.

1. The treatment effectiveness will vary seasonally with lower treatment effectiveness in the colder winter months when biological activity will be reduced.

2. The Centerville System should be more effective and will have a longer life expectancy than the Stockett Wetland Systems.

3. Treatment effectiveness will likely be best for the first growing season, with a decrease in effectiveness with time. With extended time of about two or three years, the systems should stabilize. The hope is that the Stockett Systems will improve water quality to greater than untreated and the Centerville Wetland System will improve water quality to be useable by livestock.

These life expectancies also indicate the Stockett wetland channels will require a much higher degree of maintenance due to their smaller size and greater loading rate.

D. Summary

As mentioned earlier the treatment systems installed are experimental, are not a "forever fix" to the AMD problem and will require maintenance. Maintenance can be minimized with proper operation and operation objectives. The systems installed represent the most effective and the lowest maintenance passive technology available for AMD treatment. The metal precipitate accumulated by the system will eventually require removal to keep treatment effective and will need to be disposed. Wetland substrate and limestone aggregate in the ALD's will also require replenishment. Long term maintenance of any treatment system constructed is an issue to be dealt with as the AMR program may not last in perpetuity. A suggestion would be to provide for another permanent state agency to control maintenance trust monies provided by the existing AMR program.

6. SAFETY

Personnel operating the systems should be aware that the waters which are being treated are acidic and contain elevated levels of metals, primarily Fe, Al, Zn Mn and SO_4. An additional concern is that the service holes installed on the sites may be considered confined spaces. All operations and maintenance should be conducted under applicable OSHA regulations.

7. PRIMARY REFERENCES

Primary references for the information presented in the Operation and Maintenance Plan are listed below.

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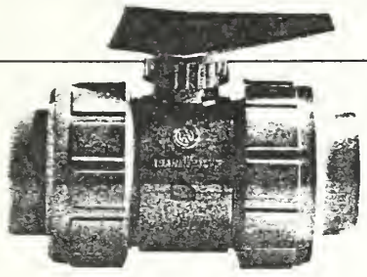
8. APPENDIX TO O&M PLAN

DUO BLOC®
TRUE UNION BALL VALVES

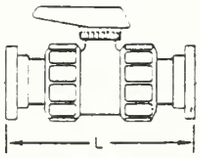
Features, Options
Sample Specifications
Parts
Pressure vs. Temperature
Dimensions



SPECIFICATIONS

SIZES ½"–6" *
MODELS Socket, Threaded, Flanged (ANSI), Butt
BODIES PVC, CPVC, PP, PVDF
SEATS Teflon® backed with EPDM or VITON®
SEALS EPDM or VITON®

FLANGED MODEL**



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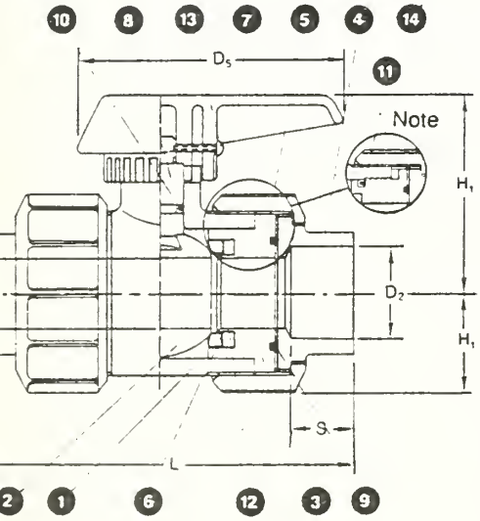


FEATURES

- True Union design eliminates the need for flanges and permits installation or repair without expanding the pipeline.
- Blocks in two directions, upstream and downstream, leaving full pressure on the opposite end of the valve.
- One-piece, capsule feature (PVC and CPVC models, ½" - 2") prevents over-tightening of seating components.
- Teflon seats with elastomeric backing cushions ensure bubble tight shut off and a low fixed torque, while at the same time compensating for wear.
- Available with EPDM or Viton® "O" rings.
- All sizes rated for full vacuum service.
- Threaded-in carriers on all sizes of PVDF and PP models and on 2½" - 4" size of CPVC and PVC models prevents over-tightening of seating components.
- Two sets of end connectors (socket and threaded) included with all PVC and CPVC models in ½"–2" sizes. This reduces by up to 50% ball valve inventories.
- Valve capsule guaranteed for 2 years when used as recommended.

OPTIONS (See options under Multiport valves)

SAMPLE SPECIFICATIONS

All thermoplastic ball valves in sizes ½" through 4" shall be of a true union design with two-way blocking capability. PVC and CPVC True Union Ball Valves (sizes ½" through 2") shall be of a one piece capsule. All PVC and CPVC True Union Ball Valves (sizes ½" through 2") shall include both socket and threaded end connectors. All True Union Ball Valves shall have Teflon® seats with elastomeric backing cushions of the same material as the valve seals. True Union Ball Valves must carry a 2 year guarantee, as manufactured by Asahi/America, Inc.

PARTS

No.	Parts	Pcs.	Materials
1	Body	1	PVC, CPVC, PP, PVDF
2	Ball	1	PVC, CPVC, PP, PVDF
3	Carrier	2	PVC, CPVC, PP, PVDF
4	Connector	2	PVC, CPVC, PP, PVDF
5	Union Nut	2	PVC, CPVC, PP, PVDF
6	Ball Seat	2	Teflon®
7	Handle	1	ABS
8	Stem	1	PVC, CPVC, PP, PVDF
9	Face "O" Ring	2	Viton®, EPDM
10	Stem "O" Ring	1	Viton®, EPDM
11	Carrier "O" Ring	2	Viton®, EPDM
12	Seat Cushion	2	Viton®, EPDM
13	Screw	1	Stainless Steel
14	Flange	2	PVC, CPVC, PP, PVDF

Note: PVC and CPVC models, size 2½", 3" and 4", and all PP and PVDF models feature threaded-in carriers.

PRESSURE VS. TEMPERATURE (PSI, WATER, NON-SHOCK)

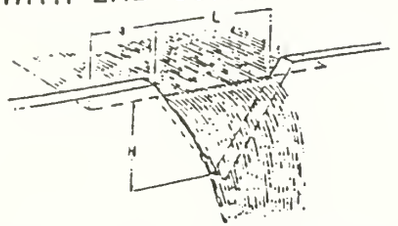
Size	PVC	CPVC				PP			PVDF			
	30°F 120°F	30°F 120°F	140°F	175°F	195°F	–5°F 85°F	140°F	175°F	–5°F 140°F	175°F	195°F	210°F
½–2"	150	150	120	85	55	150	85	60	150	120	110	85
2½–6"	150	150	20	85	55	150	70	40	150	120	110	85

IMENSIONS (IN INCHES)

Size	Weight Socket/ Threaded (lbs.)	Weight Flanged (lbs.)	D_1	D_2 Socket	D_2 Threaded	S Socket	L Butt Fusion	L Socket	L Threaded	L Flanged PVC/ CPVC/ PP/PVDF	D_5	H_2	H_1	C_v Values Gal./Min. @ 1 PSI Pressure Drop
½"	0.38	2.00	0.59	0.85	NPT ½	0.69	4.57	3.86	3.82	5.63	2.76	1.97	.95	11.9
¾"	0.67	2.25	0.79	1.06	NPT ¾	0.72	5.00	4.53	4.65	6.77	3.54	2.24	1.19	30.0
1"	1.00	2.50	0.98	1.33	NPT 1	0.87	5.35	5.28	5.35	7.36	3.94	2.64	1.38	46.8
1¼"	1.39	3.25	1.22	1.67	NPT 1¼	0.94	6.00	5.83	5.87	7.48	4.13	3.07	1.57	80.0
1½"	2.18	4.00	1.57	1.91	NPT 1½	1.09	6.29	6.65	6.69	8.35	4.53	3.35	1.87	140.0
2"	2.93	4.75	2.01	2.39	NPT 2	1.16	7.04	7.56	7.76	9.21	5.12	3.74	2.09	185.0
2½"	4.86	8.50	2.28	2.89	NPT 2½	1.75	9.70	9.45	8.46	10.20	5.91	4.45	2.62	320.0
3"	8.07	13.00	2.76	3.52	NPT 3	1.87	11.63	11.10	10.39	11.97	8.66	5.12	2.99	430.0
4"	21.00	33.00	3.54	4.52	NPT 4	2.00	14.85	13.90	14.17	14.65	11.02	6.54	4.13	720.0

*6" Ball Valve is venturied up from 4". See Page 14.
**See Page 10 for details.

DISCHARGE FROM TRIANGULAR NOTCH WEIRS WITH END CONTRACTIONS



Head (H) in Inches	Flow in Gallons Per Min.		Head (H) in Inches	Flow in Gallons Per Min.		Head (H) in Inches	Flow in Gallons Per Min.	
	90° Notch	60° Notch		90° Notch	60° Notch		90° Notch	60° Notch
¼	0.07	0.04	6¼	214	124	14½	1.756	1.014
½	0.42	0.24	6½	236	136	15	1.912	1.104
¾	1.10	0.62	6¾	260	150	15½	2.073	1.197
1	2.19	1.27	7	284	164	16	2.246	1.297
1¼	3.33	2.21	7¼	310	179	16½	2.426	1.401
1½	6.05	3.49	7½	338	195	17	2.514	1.509
1¾	8.39	5.13	7¾	367	212	17½	2.310	1.623
2	12.4	7.16	8	397	229	18	3.016	1.741
2¼	16.7	9.62	8¼	429	248	18½	3.229	1.864
2½	21.7	12.5	8½	462	267	19	3.452	1.993
2¾	27.5	15.9	8¾	498	287	19½	3.584	2.127
3	34.2	19.7	9	533	308	20	3.924	2.266
3¼	41.8	24.1	9¼	571	330	20½	4.174	2.410
3½	50.3	29.0	9½	610	352	21	4.433	2.560
3¾	59.7	34.5	9¾	651	376	21½	4.702	2.715
4	70.2	40.5	10	694	401	22	4.980	2.375
4¼	81.7	47.2	10½	784	452	22½	5.268	3.041
4½	94.2	54.4	11	880	508	23	4.565	3.213
4¾	108	62.3	11½	984	568	23½	5.873	3.391
5	123	70.8	12	1.094	632	24	6.190	3.574
5¼	139	80.0	12½	1.212	700	24½	6.518	3.763
5½	156	89.9	13	1.337	772	25	6.355	3.958
5¾	174	100	13½	1.469	848			
6	193	112	14	1.509	929			

Based on formula:

$$Q = (C)\ (4/15)\ (L)\ (H)\ \sqrt{2gH}$$

in which Q = flow of water in cu. ft. per sec.

L = width of notch in ft. at H distance above apex.

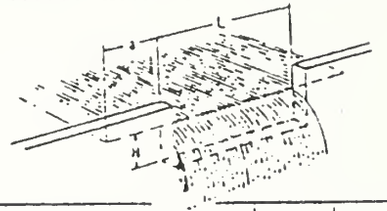
H = head of water above apex of notch in ft.

C = constant varying with conditions, .57 being used for this table.

a = should be not less than ¼L.

For 90° notch the formula becomes

DISCHARGE FROM RECTANGULAR WEIR WITH END CONTRACTIONS



Figures in Table are in Gallons Per Minute

Head (H) in Inches	Length (L) of Weir in Feet				Head (H) in Inches	Length (L) of Weir in Feet		
	1	3	5	Additional g.p.m. for each ft. over 5 ft.		3	5	Additional g.p.m. for each ft. over 5 ft.
¼	4.5	13.4	22.4	4.5	7¼	2.238	3,785	774
½	12.3	38.2	63.3	12.3	8	2,338	3,956	814
¾	23.4	70.2	117.0	23.4	8¼	2,442	4,140	850
1	35.4	108	180	36.1	8½	2,540	4,312	890
1¼	49.5	150	250	50.4	8¾	2,656	4,511	929
1½	64.9	197	330	66.2	9	2,765	4,699	970
1¾	81.0	248	415	83.5	9¼	2,876	4,399	1.011
2	98.5	302	506	102	9½	2,985	5,098	1,051
2¼	117	361	605	122	9¾	3,101	5,288	1,091
2½	136	422	706	143	10	3,216	5,490	1,136
2¾	157	485	815	165	10½	3,480	5,940	1,230
3	178	552	925	187	11	3,716	6,355	1,320
3¼	200	624	1.047	211	11½	3,960	6,780	1,410
3½	222	695	1,167	236	12	4,185	7,165	1,495
3¾	245	769	1,292	261	12½	4,430	7,595	1,575
4	269	846	1,424	288	13	4,660	8,010	1,660
4¼	294	925	1,559	316	13½	4,950	8,510	1,780
4½	313	1,006	1,696	345	14	5,215	8,980	1,885
4¾	344	1,091	1,835	374	14½	5,475	9,440	1,985
5	370	1,175	1,985	405	15	5,740	9,920	2,090
5¼	396	1,262	2,130	434	15½	6,015	10,400	2,165
5½	422	1,352	2,282	465	16	6,290	10,900	2,300
5¾	449	1,442	2,440	495	16½	6,565	11,380	2,410
6	477	1,535	2,600	538	17	6,925	11,970	2,520
6¼		1,532	2,760	560	17½	7,140	12,410	2,540
6½		1,742	2,920	596	18	7,410	12,900	2,745
6¾		1,825	3,094	630	18½	7,595	13,410	2,855
7		1,928	3,260	668	19	7,980	13,940	2,970
7¼		2,029	3,436	702	19½	8,280	14,460	3,090
7½		2,130	3,609	736				

$$Q = 3.33\ (L - 0.2H)\ H^{1.5}$$

in which

Q = cu. ft. of water flowing per second.

L = length of weir opening in feet (should be 4 to 8 times H).

SECTION B. DRINKING WATER QUALITY STANDARDS—UNITED STATES

The U.S. Environmental Protection Agency's National Primary Drinking-Water Regulations and National Secondary Drinking-Water Regulations are summarized in the following tables. The primary regulations specify maximum contaminant levels (MCLs), and health advisories. The MCLs, which are the maximum permissible level of a contaminant in water at the tap, are health related and are legally enforceable. If these concentrations are exceeded or if required monitoring is not performed the public must be notified. The secondary drinking-water regulations specify the secondary maximum contaminant levels (SMCL). The SMCLs are for contaminants in drinking water that primarily affect the esthetic qualities related to public acceptance of drinking water; they are intended to be guidelines for the States and and are not federally enforceable. Health advisories are guidance contaminant levels that would not result in adverse health effects over specified short-time periods for most people.

As provided by the Safe Drinking Water Act of 1974, the U.S. Environmental Protection Agency has the primary responsibility for establishing and enforcing regulations. However, States may assume primacy if they adopt regulations that are at least as stringent as the Federal regulations in levels specified for protection of public health and in provision of surveillance and enforcement. The States may adopt more stringent regulations and may establish regulations for other constituents.

TABLE 6–13. NATIONAL PRIMARY DRINKING WATER STANDARDS

Constituent	MCL mg/L	Constituent	MCL mg/L
INORGANICS		Lindane	0.004
Arsenic (AS)	0.05	Methoxychlor	0.1
Barium (Ba)	1.0	Toxaphene	0.005
Cadmium (Cd)	0.01	Total trihalomethanes	0.10
Chromium (Cr)	0.05	RADIONUCLIDES	
Fluoride (F)	4.0	Beta particle and photon	
Lead (Pb)	0.05	activity, mrem	4 (annual dose equivalent)
Mercury (Hg)	0.002	Gross alpha , pCi/L	15
Nitrate (as N)	10.0	Radium-226 and 228, pCi/L	5
Selenium (Se)	0.01	VOLATILE ORGANIC CHEMICALS	
Silver (Ag)	0.05	Benzene	0.005
MICROBIOLOGICALS		Carbon tetrachloride	0.005
Coliforms	1/100 mL	1,2-Dichloroethane	0.005
PHYSICAL CHARACTERISTICS		1,1-Dichloroethylene	0.007
Turbidity, NTU	1–5	1,1,1-Trichloroethane	0.20
ORGANICS		para-Dichlorobenzene	0.075
2, 4-D	0.1	Trichloroethylene	0.005
2,4,5-TP Silvex	0.01	Vinyl chloride	0.002
Endrin	0.0002		

Source: U.S. Environmental Protection Agency

TABLE 6–14. NATIONAL SECONDARY DRINKING WATER STANDARDS

Constituent	SMCL Level (mg/L)	Constituent	SMCL Level (mg/L)
Chloride (Cl)	250	Manganese (Mn)	0.05
Color, color units	15	Odor, threshold odor number	3
Copper (Cu)	1	pH, pH units	6.5–8.5
Corrosivity	Noncorrosive	Sulfate (SO_4)	250
Fluoride	2.0	Total dissolved solids (TDS)	500
Surfactants (MBAS)	0.5	Zinc (Zn)	5.0
Iron (Fe)	0.3		

HEALTH ADVISORY

Constituent	Level (mg/L)
Sodium	20

Source: U.S. Environmental Protection Agency

NOTES FOR FIGURE 6–6

Sodium-Adsorption-Ratio SAR = Na/ (Ca + Mg)/2 where concentrations are expressed in millequivalents per liter.

CONDUCTIVITY

LOW-SALINITY WATER (C1) can be used for irrigation with most crops on most soils with little likelihood that soil salinity will develop. Some leaching is required, but this occurs under normal irrigation practices except in soils of extremely low permeability.

MEDIUM-SALINITY WATER (C2) can be used if a moderate amount of leaching occurs. Plants with moderate salt tolerance can be grown in most cases without special practices for salinity control.

HIGH-SALINITY WATER (C3) cannot be used on soils with restricted drainage. Even with adequate drainage, special management for salinity control may be required and plants with good salt tolerance should be selected.

VERY HIGH-SALINITY WATER (C4) is not suitable for irrigation under ordinary conditions, but may be used occasionally under very special circumstances. The soils must be permeable, drainage must be adequate, irrigation water must be applied in excess to provide considerable leaching, and very salt-tolerant crops should be selected.

SODIUM

LOW-SODIUM WATER (S1) can be used for irrigation on almost all soils with little danger of the development of harmful levels of exchangeable sodium. However, sodium-sensitive crops such as stone-fruit trees and avocados may accumulate injurious concentrations of sodium.

MEDIUM-SODIUM WATER (S2) will present an appreciable sodium hazard in fine-textured soils having high cation-exchange-capacity, especially under low-leaching conditions, unless gypsum is present in the soil. This water may be used on coarse-textured or organic soils with good permeability.

HIGH-SODIUM WATER (S3) may produce harmful levels of exchangeable sodium in most soils and will require special soil management—good drainage, high leaching, and organic matter additions. Gypsiferous soils may not develop harmful levels of exchangeable sodium from such waters. Chemical amendments may be required for replacement of exchangeable sodium, except that amendments may not be feasible with waters of very high salinity.

VERY HIGH SODIUM WATER (S4) is generally unsatisfactory for irrigation purposes except at low and perhaps medium salinity, where the solution of calcium from the soil or use of gypsum or other amendments may make the use of these waters feasible.

Another criterion for the evaluation of irrigation water is:

Residual Sodium Carbonate (RSC) = $(CO_3 + HCO_3) - (Ca + Mg)$ where concentrations are expressed in meq/liter.

When RSC>2.5 Probably not suitable for irrigation

1.25–2.5 Marginal

<1.25 Probably safe for irrigation

TABLE 6–46. GUIDES FOR EVALUATING THE QUALITY OF WATER USED FOR IRRIGATION

[MPN is most probable number. Sodium absorption ratio is defined by the formula SAR=Na/ (Ca+Mg)/2 where the concentrations are expressed in milliequivalents per liter. Residual sodium carbonate is the sum of the equivalents of normal carbonate and bicarbonate minus the sum of the equivalents of calcium and magnesium.]

Quality Factor	Threshold Concentration*	Limiting Concentration†
Coliform organisms, MPN per 100 ml	1000‡	§
Total dissolved solids (TDS), mg/liter	500‡	1500‡
Electrical conductivity, µmhos/cm	750‡	2250‡
Range of pH	7.0–8.5	6.0–9.0
Sodium adsorption ratio (SAR)	6.0‡	15
Residual sodium carbonate (RSC), meq	1.25‡	2.5
Arsenic, mg/liter	1.0	5.0
Boron, mg/liter	0.5‡	2.0
Chloride, mg/liter	100‡	350
Sulfate, mg/liter	200‡	1000
Copper, mg/liter	0.1‡	1.0

*Threshold values at which irrigator might become concerned about water quality and might consider using additional water for leaching. Below these values, water should be satisfactory for almost all crops and almost any arable soil.

† Limiting values at which the yield of high-value crops might be reduced drastically, or at which an irrigator might be forced to less valuable crops.

‡ Values not to be exceeded more than 20 percent of any 20 consecutive samples, nor in any 3 consecutive samples. The frequency of sampling should be specified.

§ Aside from fruits and vegetables which are likely to be eaten raw, no limits can be specified. For such crops, the threshold concentration would be limiting.

Source: Calif. State Water Quality Control Board, 1963

TABLE 6–51. GUIDES FOR EVALUATING THE QUALITY OF WATER FOR AQUATIC LIFE

Determination	Threshold Concentration*	
	Freshwater	Saltwater
Total dissolved solids (TDS), mg/liter	2000†	
Electrical conductivity, µmhos/cm @ 25°C	3000†	
Temperature, maximum °C	34	34
Maximum for salmonoid fish	23	23
Range of pH	6.5–8.5	6.5–9.0
Dissolved oxygen (D.O.), minimum mg/liter	5.0‡	5.0‡
Flotable oil and grease, mg/liter	0	0†
Emulsified oil and grease, mg/liter	10†	10†
Detergent, ABS, mg/liter	2.0	2.0
Ammonia (free), mg/liter	0.5†	
Arsenic, mg/liter	1.0†	1.0†
Barium, mg/liter	5.0†	
Cadmium, mg/liter	0.01†	
Carbon dioxide (free), mg/liter	1.0	
Chlorine (free), mg/liter	0.02	
Chromium, hexavalent, mg/liter	0.05†	0.05†
Copper, mg/liter	0.02†	0.02†
Cyanide, mg/liter	0.02†	0.02†
Fluoride, mg/liter	1.5†	1.5†
Lead, mg/liter	0.1†	0.1†
Mercury, mg/liter	0.01	0.01
Nickel, mg/liter	0.05†	
Phenolic compounds, as phenol, mg/liter	1.0	
Silver, mg/liter	0.01	0.01
Sulfide, dissolved, mg/liter	0.5†	0.5†
Zinc, mg/liter	0.1	

* Thresnold concentration is value that normally might not be deleterious to fish life. Waters that do not exceed these values should be suitable habitats for mixed fauna and flora.
† Values not to be exceeded more than 20 percent of any 20 consecutive samples, nor in any 3 consecutive samples. Other values should never be exceeded. Frequency of sampling should be specified.
‡ Dissolved oxygen concentrations should not fall below 5.0 mg/liter more than 20 percent of the time and never below 2.0 mg/liter. (Note: Recent data indicate also that rate of change of oxygen tension is an important factor, and that diurnal changes in D.O. may, in sewage-polluted water, render the value of 5.0 of questionable merit.)
Source: Calif. State Water Quality Control Board, 1963

TABLE 6–52. MAXIMUM CONCENTRATIONS OF COPPER SULFATE SAFE FOR FISH

Fish	Safe Copper Sulfate Concentration	
	ppm.	lb./mil. gal.
Trout	0.14	1.2
Carp	0.30	2.5
Suckers	0.30	2.5
Catfish	0.40	3.5
Pickerel	0.40	3.5
Goldfish	0.50	4.0
Perch	0.75	6.0
Sunfish	1.20	10.0
Black Bass	2.10	17.0

Source: U.S. Public Health Service

SECTION H. RECREATIONAL WATER QUALITY

TABLE 6–54. GUIDES FOR EVALUATING RECREATIONAL WATERS

Determination	Water Contact		Boating and Aesthetic	
	Noticeable Threshold	Limiting Threshold	Noticeable Threshold	Limiting Threshold
Coliforms, MPN per 100 ml	1000*	†		
Visible solids of sewage origin	None	None	None	None
ABS (detergent), mg/liter	1*	2	1*	5
Suspended solids, mg/liter	20*	100	20*	100
Flotable oil and grease, mg/liter	0	5	0	10
Emulsified oil and grease, mg/liter	10*	20	20*	50
Turbidity, silica scale units	10*	50	20*	‡
Color, standard cobalt scale units	15*	100	15*	100
Threshold odor number	32*	256	32*	256
Range of pH	6.5–9.0	6.0–10.0	6.5–9.0	6.0–10.0
Temperature, maximum °C	30	50	30	50
Transparency, Secchi disk, ft	. . .	. . .	20*	‡

* Value not to be exceeded in more than 20 percent of 20 consecutive samples, nor in any 3 consecutive samples.

† No limiting concentration can be specified in the basis of epidemiological evidence, provided no fecal pollution is evident.

(Note: Noticeable threshold represents the level at which people begin to notice and perhaps to complain. Limiting threshold is the level at which recreational use of water is prohibited or seriously impaired.

‡ No concentration likely to be found in surface waters would impede use.

Source: California State Water Quality Control Board, 1963

SECTION I. WATER QUALITY FOR LIVESTOCK

TABLE 6–55. GUIDES FOR EVALUATING THE QUALITY OF WATER USED BY LIVESTOCK

Quality Factor	Threshold Concentration*	Limiting Concentration†
Total dissolved solids (TDS), mg/liter	2500	5000
Cadmium, mg/liter	5	
Calcium, mg/liter	500	1000
Magnesium, mg/liter	250	500‡
Sodium, mg/liter	1000	2000‡
Arsenic, mg/liter	1	
Bicarbonate, mg/liter	500	500
Chloride, mg/liter	1500	3000
Fluoride, mg/liter	1	6
Nitrate, mg/liter	200	400
Nitrite, mg/liter	None	None
Sulfate, mg/liter	500	1000‡
Range of pH	6.0–8.5	5.6–9.0

*Threshold values represent concentrations at which poultry or sensitive animals might show slight effects from prolonged use of such water. Lower concentrations are of little or no concern.
† Limiting concentrations based on interim criteria, South Africa. Animals in lactation or production might show definite adverse reactions.
‡ Total magnesium compounds plus sodium sulfate should not exceed 50 percent of the total dissolved solids.
Source: California State Water Quality Control Board, 1963

TABLE 6–56. QUALITY STANDARDS FOR WATER USED FOR LIVESTOCK

	Threshold Salinity Concentration, ppm.
Poultry	2,860
Pigs	4,290
Horses	6,435
Cattle, dairy	7,150
Cattle, beef	10,000
Adult dry sheep	12,900

Source: Jour. of Agriculture of Western Australia, 1950

CASCADE MINE DRAINAGE
WATER SAMPLE RESULTS

		CONSTITUENT **																
Sample Date	Sample Description	pH* s.u.	Flow gpm*	Temp.* C*	Cond.* mS/cm	TDS* g/l	DO* mg/l	Acidity mg/l $CaCO_3$	Alkalinity Mg/l $CaCO_3$	pH s.u.	TDS mg/l	S.Cond. umhos/cm	SO_4 mg/l	Al mg/l	Mn mg/l	Fe ** mg/l	Fe *** mg/l	Zn mg/l
10-Sept-91	CC Outlet Pipe			11.5			9.8											
10-Sept-91	SSE S Pipe @ Highway Ditch			14.0			9.2											
25-Sept-91	CC Outlet Pipe			11.0			0.3											
25-Sept-91	SSE N Pipe by Highway			13.5			0.2											
25-Sept-91	SSE in Cleanout from SE Coulee Int			13.0			0.2											
25-Sept-91	SSE in Cleanout from E Hill Int.			13.5			5.8											
26-Sept-91	SSE in Cleanout from SE Coulee Int.			13.5			2.0											
26-Sept-91	SSE N Pipe by Highway			14.0			7.0											
26-Sept-91	SSE S Pipe @ Highway Ditch			14.0			4.0											
26-Sept-91	CC Outlet Pipe			12.0			7.7											
02-Oct-91	SSE in Cleanout from SE Coulee Int			13.5			0.4											
02-Oct-91	CC Outlet Pipe							1950		2.6	4040		2710	215	1.31	86	191	2.20
02-Oct-91	CC Outlet Pipe - Dup.							2030		2.6	4040		2660	210	1.30	86	191	2.24
20-Nov-91	SSE in Cleanout From E Hill	2.1			9.35	4.68	2.0											
20-Nov-91	SSE in Cleanout from SE Coulee	3.0			10.57	5.29	3.3											
20-Nov-91	SSE S Pipe @ Highway Ditch	2.6	2.38		8.74	4.37	0.4											
20-Nov-91	CC Outlet Pipe	2.6	5.25		3.38	1.70	3.0											
26-Nov-91	SSE from SE Coulee							10800	0	2.5	22100	10900	13200	1290	6.22	2150	<0.1	82.9
26-Nov-91	SSE from E Hill Int.							11100	0	2.5	19400	8730	13300	1180	6.46	149	931	73.0
26-Nov-91	SSE W Int. System							9800	0	3.1	17400	9270	10800	1000	7.36	1160	220	60.6
26-Nov-91	SSE N Hill Upper Int.							9700	0	2.7	19500	9780	12800	1330	5.35	1650	<0.1	66.5
26-Nov-91	SSE N Hill Lower Int							11000	0	2.9	18600	9440	11900	1340	5.59	1030	200	69.9
26-Nov-91	SSE N Hill Lower Int. - Spike % Rec							N/A	N/A	N/A	N/A	N/A	107	99	98	102	N/A	100
26-Nov-91	CC Outlet Pipe							2210	0	2.6	3930	3430	2610	208	1.26	90	115	2.23
26-Nov-91	CC Outlet Pipe - Dup.							2190	0	2.6	3940	3450	2640	204	1.26	89	114	2.22

* Field Measured
** All Samples Non Filtered

CASCADE MINE DRAINAGE
WATER SAMPLE RESULTS

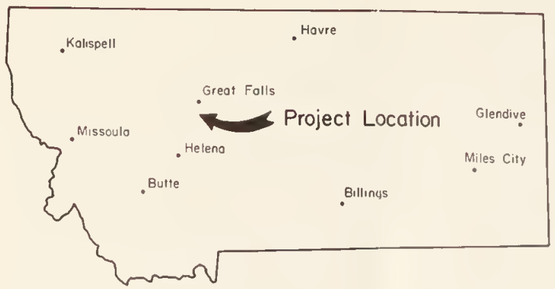
		CONSTITUENT**															
Sample Date	Sample Description	pH* s.u.	Flow gpm*	Temp.* C*	Cond.* mS/cm	TDS* g/l	DO* mg/l	Acidity mg/l $CaCO_3$	Alkalinity Mg/l $CaCO_3$	pH s.u.	TDS mg/l	S.Cond. umhos/cm	SO_4 mg/l	Al mg/l	Mn mg/l	Fe** mg/l	Fe*** mg/l	Zn mg/l
26-Feb-92	CC Outlet Pipe		5.0	9.0			8.0	2520	0	3.4	3940	3320	2830	238	1.41	82	217	2.00
26-Feb-92	SSE S Pipe @ Hwy Ditch		1.33	6.0			1.3	12000	0	3.3	17500	10000	13000	1270	7.16	1290	650	66.3
26-Feb-92	SSE N Int. Combined		1.33	5.0			5.3	13600	0	3.2	20500	10200	13200	1510	5.78	1049	51	70.2
15-July-92	SSE N. Wetland Bypass Outlet		1.1															
15-July-92	SSE S. Pipe @ Hwy Ditch		1.78															
22-July-92	CC Bypass Outlet							2240	0	2.7		3350	2840	198	1.32	62	239	2.09
22-July-92	SSE S. Pipe @ Hwy Ditch							10000	0	2.9		8980	10500	1120	6.36	1440	170	61
22-July-92	SSE N. Wetland Bypass Outlet							7830	0	3.2		9010	9340	510	12.2	2410	<0.1	48.7
06-Aug-92	SSE S. Pipe @ Highway Ditch	2.9	1.58	14.0	7.88	3.97	1.5											
06-Aug-92	SSE N. Wetland Bypass Outlet	2.6	1.98	27.0	9.08	9.54	1.8											
06-Aug-92	CC @ Wetland Bypass Outlet	2.4	4.75	13.5	2.97	1.48	1.3											
06-Aug-92	CC @ Collector Basin	3.81	0	24.0	3.27	1.64	10.2											
12-Aug-92	SSE N. Wetland Bypass Outlet							2790	0	2.6	17900	9560	12900	928	8.12	1680	410	67.5
12-Aug-92	SSE S. Pipe @ Hwy Ditch							2060	0	2.6	17200	8890	6.75	1030	6.75	1180	420	65.8
12-Aug-92	CC @ Wetland Bypass Outlet							438	0	2.6	4000	3510	2810	219	1.50	50.0	212	2.25
	CC used for calcs.		6					1733						218	1.4	287 Fe tot		
	SSE N. used for calcs.		3					8073						983	8.7	1867 Fe tot		
	SSE S. used for calcs.		3					8020						1140	6.8	1717 Fe tot		
	Legend: CC = Centerville "C" site SSE = Stockett SE site Int. = Interceptor Dup. = Duplicate Rec. = Recovery																	

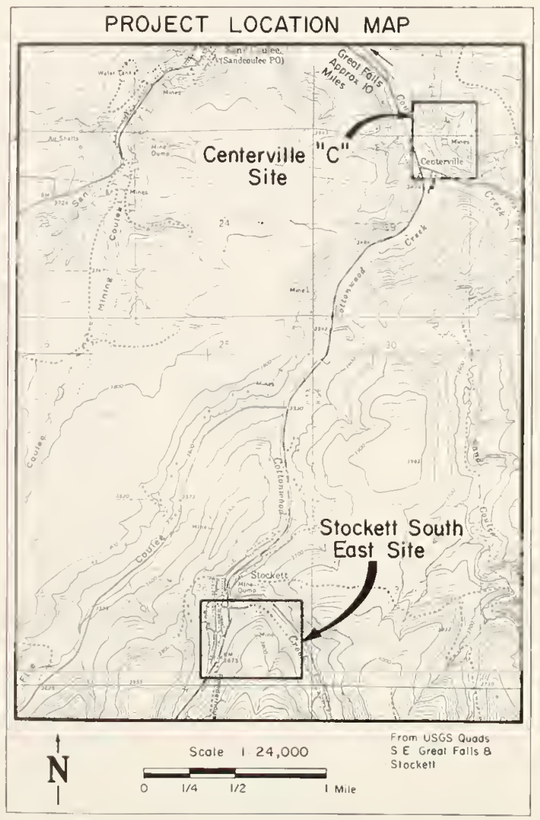
* Field Measured
** All Samples Non Filtered

Attachment G. Record Drawings

CASCADE MINE DRAINAGE - PHASE I

MONTANA DEPARTMENT OF STATE LANDS
ABANDONED MINE RECLAMATION BUREAU
AMRB NO. 91-001




PROJECT LOCATION MAP
Centerville "C" Site
Stockett South East Site
Great Falls Approx. 10 Miles
Scale 1 24,000
0 1/4 1/2 1 Mile
From USGS Quads S E Great Falls & Stockett
N

SHEET INDEX

COVER AND PROJECT LOCATION	1
CENTERVILLE "C" SITE	2
STOCKETT SOUTHEAST SITE	3
DETAIL SHEETS	4-9
CROSS SECTIONS	10-12

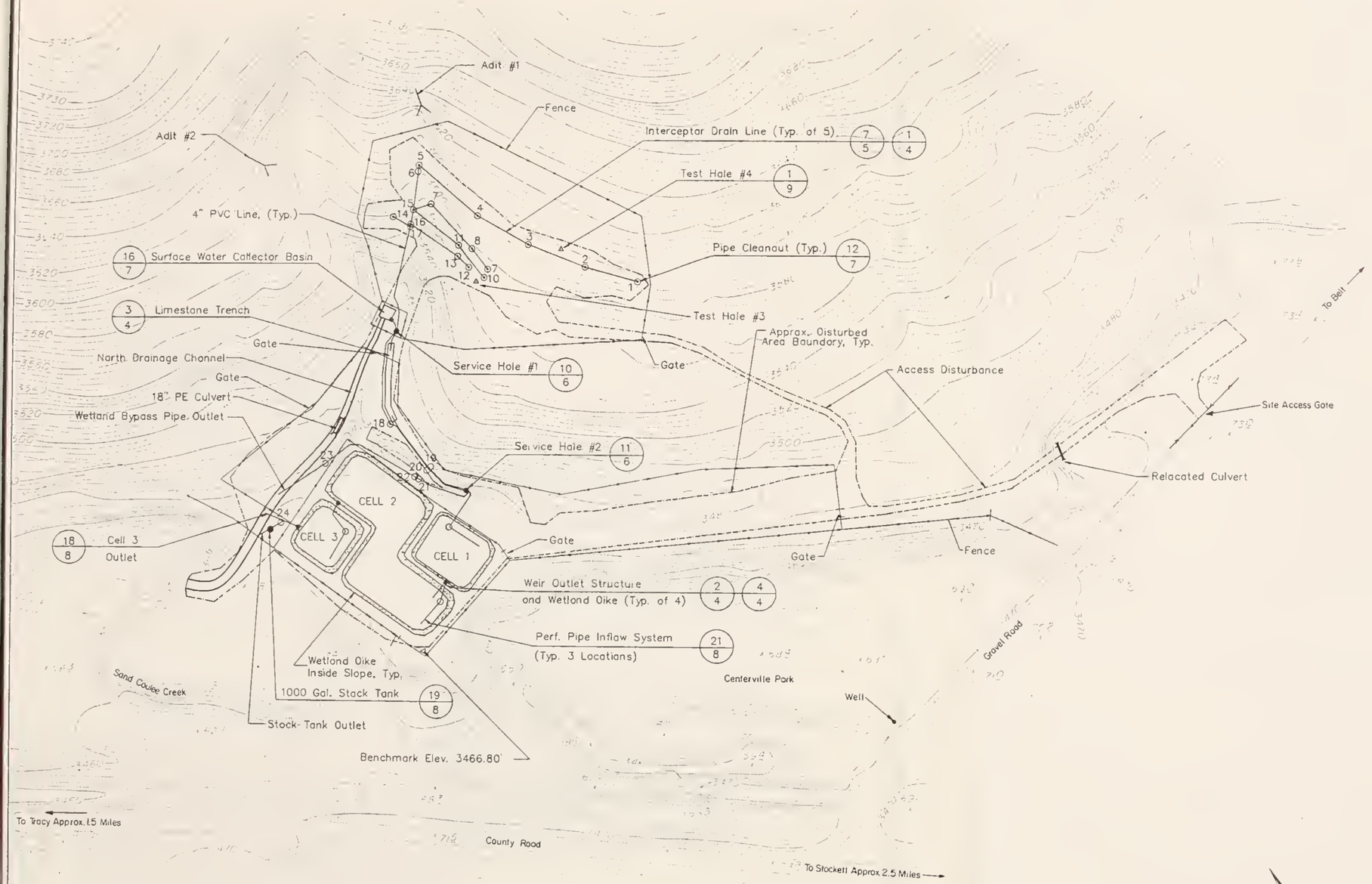
RECORD DRAWINGS 12/92

ROBERT PECCIA & ASSOCIATES, HELENA, MT. · RPA ·

Designed by: R.B. MORTON
Drawn by: S.H. HINES
Checked by: D.E. WIDMAYER
Approved by: R.J. PECCIA

MONTANA ROBERT J. PECCIA 3275E REGISTERED PROFESSIONAL ENGINEER

Date : May, 1991
SHEET 1
Set Number: _____



CENTERVILLE "C" SITE

- Removed and relocated existing 42" CMP to new site access location.
- Removed and salvaged existing fences.
- Constructed access roads.
- Installed 20' of 18" PE culvert under new access road across north drainage.
- Closed Adit #2 & #1.
- Constructed interceptor drains, locations shown on the Record Drawings.
- Cleaned out existing 4" PVC line.
- Provided trench dewatering. Discharged into bypass systems, not into wetland cells or limestone trenches.
- Installed PVC drain pipes connecting the interceptor trenches to the drain lines leading to the discharge areas. The Contractor made all necessary connections and provided concrete anchors (thrust blocks).
- Provided pipe cleanouts every 100' on all new pipe runs including those in the interceptor drains. Approximate pipe depth below ground surface at each cleanout found in attachment to Record Drawings.
- All piping buried a minimum depth of 4'. Additional cover material placed over any sections of pipe not be buried 4' deep due to bedrock or other factors.
- Constructed surface collection basin with weir outlet structure.
- Constructed limestone trench.
- Installed limestone veneer at small seep locations.
- Installed 2 service holes and provided PVC fittings.
- Excavated and stockpiled all topsoil and subsoil from the areas where the wetland cells were constructed.
- Constructed 3 wetland cells.
- Graded slope upgrade of the cells to provide a route around the cells for surface runoff.
- Installed outflow ditches from the wetland cells to the adjacent cell or drainage channel.
- Provided 1000 gallon fiberglass stock tank with valve and piping.
- Removed and salvaged existing 12" PVC pipe near stream channel to on-site location and to landowner.
- Regraded north drainage channel.
- Installed weir structures and wetland piping.
- Installed bentonite seal, liner, gravel, and peat in wetland cells. Installed hay bale dikes in the wetland cells.
- Transplanted wetland vegetation in wetland cells.
- Flooded wetland cells with clean water (source from nearby Centennial Park well). This was done a minimum of one week before turning on mine drainage.
- Reclaimed all areas within the project site that did not support a healthy stand of vegetation. All areas disturbed during construction also were reclaimed.
- Reclamation consisted of an initial grading to remove erosion rills. Application and incorporation of lime to existing devegetated areas. Placement of 4" cover soil on limed areas. Soil generated by on site and imported. Fertilized, seeded and mulched all devegetated areas as well as construction disturbed areas including temporary haul/access roads. Construction disturbed area seedbed preparation included regrading and ripping.
- Grading of devegetated area #1 also included grading slumped soil to create a uniform slope while constructing a 5' wide slope terrace. The terrace is sloped approximately 1% into the hill and has about a 1% grade toward the existing drainage.
- Constructed a permanent 5-strand barbed-wire farm fence (Type F-5M) around the wetland cells and the surface collection basin.
- Installed sections of 4-strand farm fence type (F-4M) as shown on the Record Drawings.
- Installed Erosion control mat on devegetated area #1 and north drainage channel.
- Transplanted trees to Centerville Park.

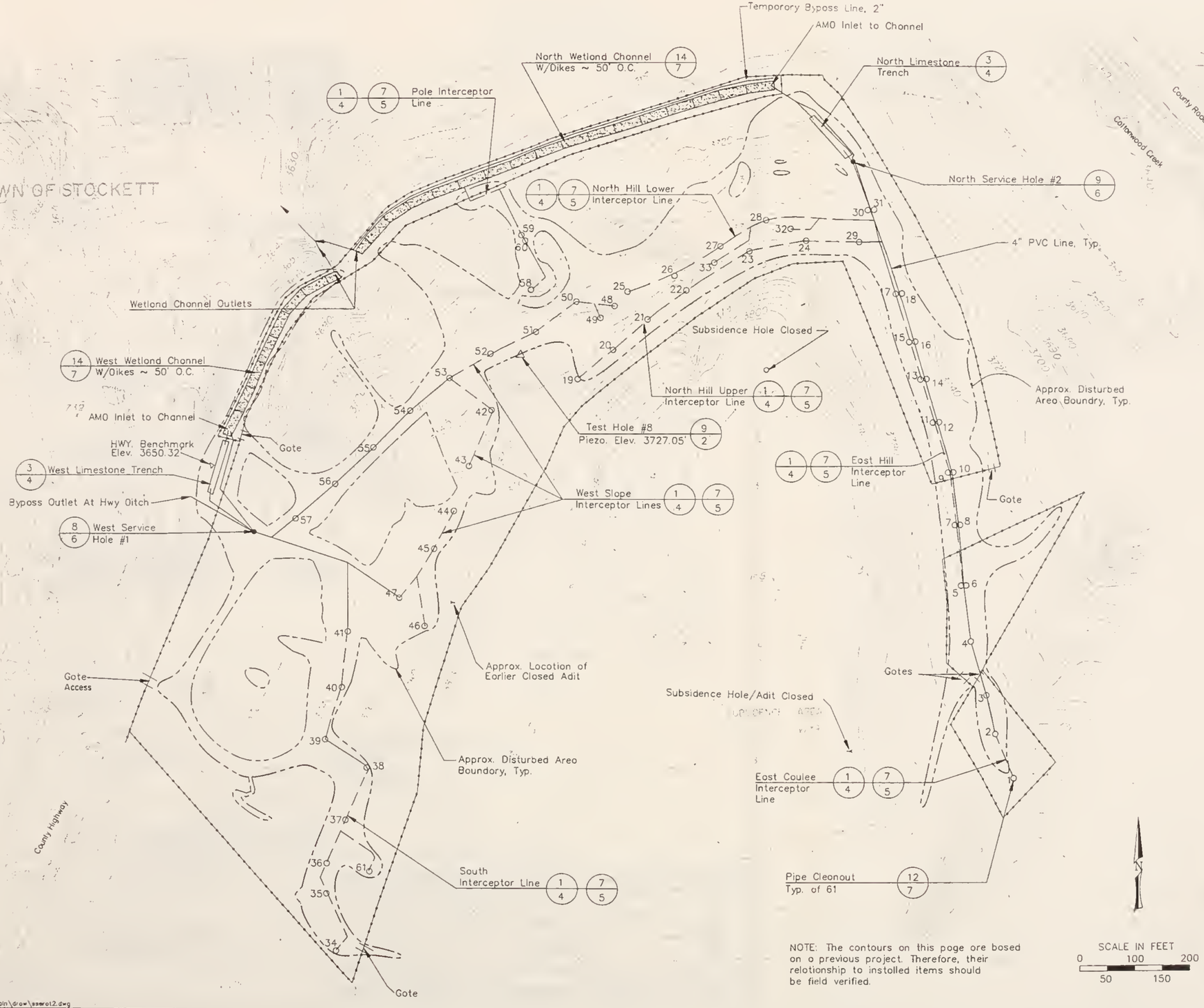
NOTE: Contour base map is based on a previous project. Therefore, their relationship to installed items should be field verified.

SCALE IN FEET
0 100 200
50 150

RECORD DRAWINGS

Project No.: 91-001	Sheet Title: CENTERVILLE "C" SITE
Date: 12\92	
Designed By: RBM	Project Title: Cascade Mine Drainage
Drawn By: NLL	2
Checked By: NGC	Sheet 2 of 12

•Robert Peccia & Associates • Helena, MT • RPA•


Temporory Bypass Line, 2"
AMO Inlet to Channel
North Wetland Channel W/Dikes ~ 50' O.C. 14/7
North Limestone Trench 3/4
1/4 7/5 Pole Interceptor Line
TOWN OF STOCKETT
Cottonwood Creek
County Road (Gravel)
North Service Hole #2 9/6
1/4 7/5 North Hill Lower Interceptor Line
4" PVC Line, Typ.
Wetland Channel Outlets
Subsidence Hole Closed
14/7 West Wetland Channel W/Dikes ~ 50' O.C.
North Hill Upper Interceptor Line 1/4 7/5
Approx. Disturbed Area Boundry, Typ.
AMO Inlet to Channel
HWY. Benchmark Elev. 3650.32
Gate
Test Hole #8 Piezo. Elev. 3727.05' 9/2
3/4 West Limestone Trench
1/4 7/5 East Hill Interceptor Line
Gate
Byposs Outlet At Hwy Ditch
West Slope Interceptor Lines 1/4 7/5
8/6 West Service Hole #1
Approx. Locotion of Eorlier Closed Adit
Gate Access
Gates
Subsidence Hole/Adit Closed
Approx. Disturbed Area Boundory, Typ.
County Highway
East Coulee Interceptor Line 1/4 7/5
South Interceptor Line 1/4 7/5
Pipe Cleonout Typ. of 61 12/7
Gate
N
SCALE IN FEET
0 100 200
50 150
NOTE: The contours on this page are based on a previous project. Therefore, their relationship to installed items should be field verified.
S:\mining\cosdrain\draw\asbuilt2.dwg

STOCKETT SE SITE

- Protected from cattle entering work area.
- Constructed access roads.
- Installed interceptor drains, locations shown on the Record Drawings.
- Installed 4" PVC drain pipes and bypass lines that lead from the interceptor drains to the limestone trenches and the discharge areas. The Contractor made all necessary connections and provided concrete anchors (thrust blocks).
- Installed 2 pre-cast concrete service holes and provided PVC fittings as required.
- Constructed 2 limestone trenches.
- Installed limestone veneer at small seep locations.
- Provided trench dewatering. Temporary piping was left in place at the North Wetland Channel.
- Installed pipe cleanouts every 100' on all pipe runs including those in the interceptor drains. Approximate pipe depth below ground surface at each cleanout found in attachment to Record Drawings.
- All piping was buried at a minimum depth of 4'. Additional cover material was placed over sections of pipe that were buried 4' deep due to bed rock or other factors.
- Excavated and stockpiled all topsoil and subsoil from the areas where the wetland channels, trench drains, and limestone trenches were constructed.
- Constructed the wetland channels, including bentonite seal, liner system, gravel and peat.
- Transplanted wetland vegetation in the wetland channel.
- Reclaimed all areas within the project site that did not support a healthy stand of vegetation. All areas disturbed during construction were also reclaimed.
- Reclamation consisted of an initial grading to remove existing erosion rills. Application and incorporation of lime to devegetated areas. Placement of 4" of cover soil on limed areas. Soil generated on site and imported. Fertilized, seeded and mulched all disturbed areas including temporary haul/access roads. Road seedbed preparation included ripping.
- Constructed a permanent 5-strand barbed wire fence (Type F-5M) around the wetland channel.
- Farm fence disturbed during construction was repaired to standards specified in the Standard Specifications.
- Hand Close Adit #1 and Adit #2.

RECORD DRAWINGS

Project No.: 91-001	Sheet Title: STOCKETT SE SITE
Date: 12\92	3
Designed By: RBM	Project Title: Cascade Mine Drainage
Drawn By: NLL	Sheet 3 of 12
Checked By: NGC	

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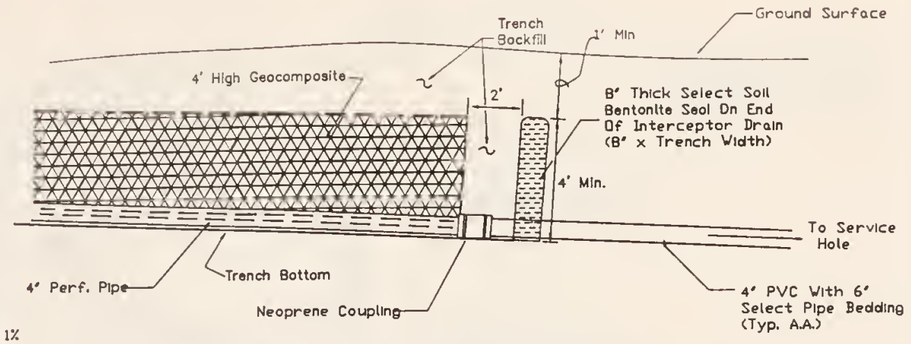
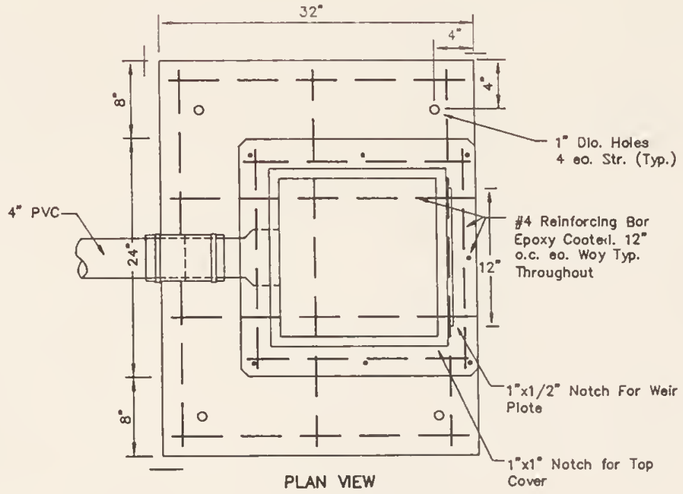
RECORD DRAWING NOTE: -Installed Structure is round not square.
-Cell 1 Structure has 2 outlet pipes.



NOTES: -Minimum Slope 1%
-See Detail 7/5

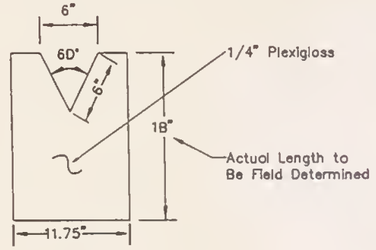
Side View of Interceptor Drain At Downgradient End

Not To Scale — 1/4

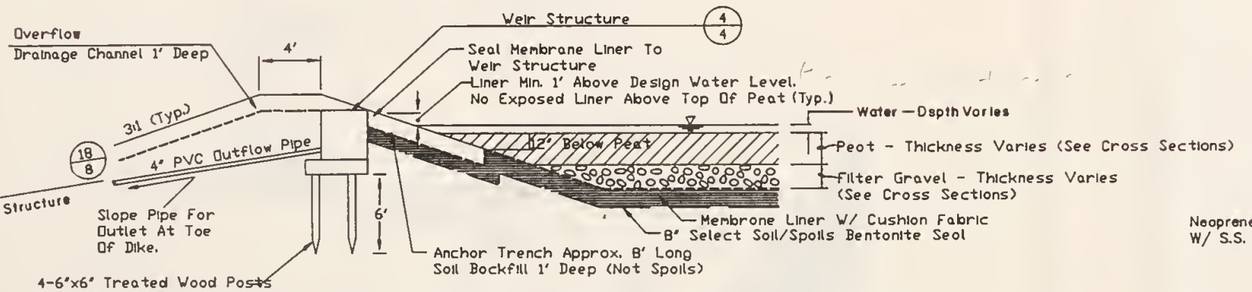


PLAN VIEW

NOTE: Contractor Shall Supply and Install 1-18"x18"x1" Plank Cover, 4-12"x3/4" Galvanized Log Bolts With 2 Washers, & 4-6"x6" Sq. and 6' Long Treated Wood Posts for Eo. Outlet Structure. All Exposed Conc. Edges Shall Have 3/4 " Chamfer.



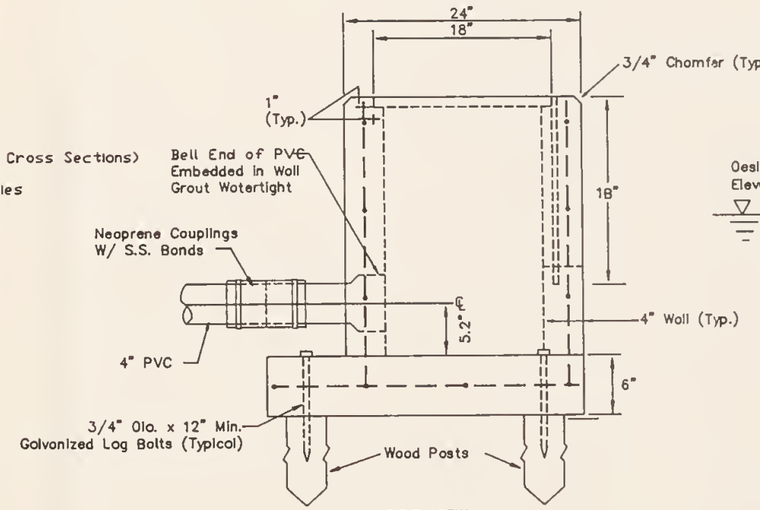
WEIR PLATE


Overflow Drainage Channel 1' Deep
4'
Weir Structure 4/4
Seal Membrane Liner To Weir Structure
Liner Min. 1' Above Design Water Level. No Exposed Liner Above Top Of Peat (Typ.)
Water — Dspth Varies
3:1 (Typ.)
18/8
4" PVC Outflow Pipe
12" Below Peat
Peat - Thickness Varies (See Cross Sections)
Filter Gravel - Thickness Varies (See Cross Sections)
To Outflow Structure
Slope Pipe For Outlet At Toe Of Dike.
6'
Membrane Liner W/ Cushion Fabric
8" Select Soil/Spoils Bentonite Seal
Anchor Trench Approx. 8' Long Soil Backfill 1' Deep (Not Spoils)
4-6"x6" Treated Wood Posts Driven Into Dike As Foundation For Outflow Structure. Posts To Be Centered Under Holes In Outflow Structure and Connected With Lag Bolts.

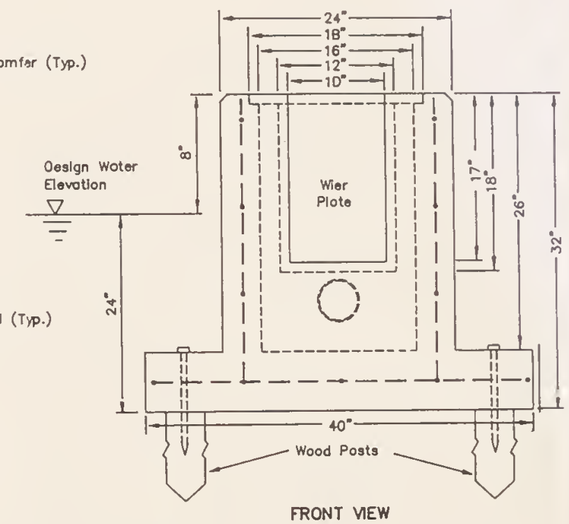
Wetland Dike and Anchor Trench Detail

Approx. Scale — 2/4

0 5 10 15 feet



SIDE VIEW

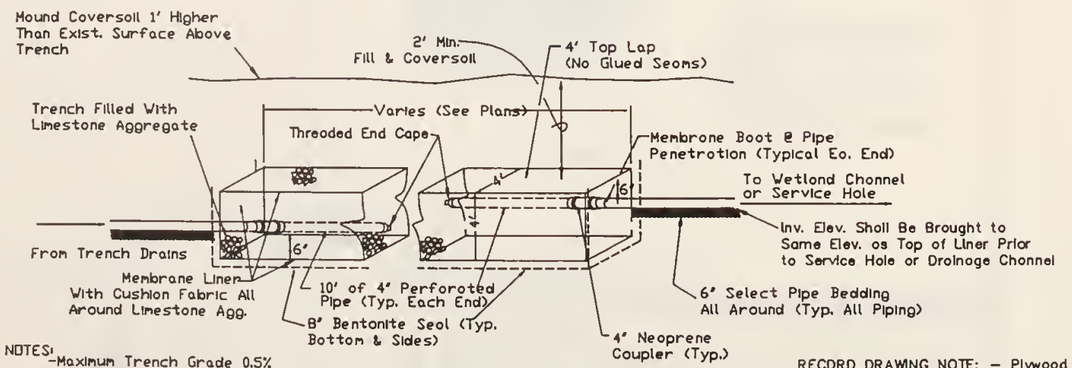


FRONT VIEW

Weir Outlet Structure No. 1

Approx. Scale — 4/4

0 4" 8" 16" 24"


Mound Coversoil 1' Higher Than Exist. Surface Above Trench
2' Min. Fill & Coversoil
4' Top Lap (No Glued Seams)
Trench Filled With Limestone Aggregate
Varies (See Plans)
Threaded End Cape
Membrane Boot @ Pipe Penetration (Typical Eo. End)
To Wetland Channel or Service Hole
6'
From Trench Drains
Inv. Elev. Shall Be Brought to Same Elev. as Top of Liner Prior to Service Hole or Drainage Channel
Membrane Liner With Cushion Fabric All Around Limestone Agg.
10' of 4" Perforated Pipe (Typ. Each End)
6" Select Pipe Bedding All Around (Typ. All Piping)
8" Bentonite Seal (Typ. Bottom & Sides)
4" Neoprene Coupler (Typ.)

NOTES: -Maximum Trench Grade 0.5%
-All Seams Glued To Manufacturer's Recommendations Except Top

Limestone Trench

Not to Scale — 3/4

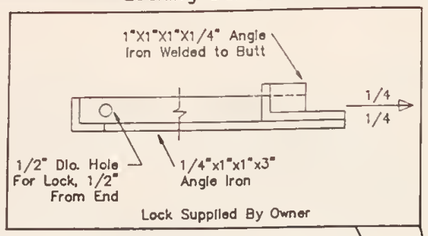
RECORD DRAWING NOTE: - Plywood forms left in place during construction, are located between membrane liner and bentonite seal on sides and ends.

RECORD DRAWINGS 12/92

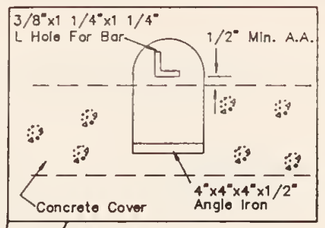
Project No.: 91-001	Sheet Title: Miscellaneous Details
Date: May 1991	4
Designed By: R. Morton	Project Title: Cascade Mine Drainage
Drawn By: S. Hathhorn	Sheet 4 of 12
Checked By: D. Widmayer	

·Robert Peccia & Associates · Helena, MT · RPA·

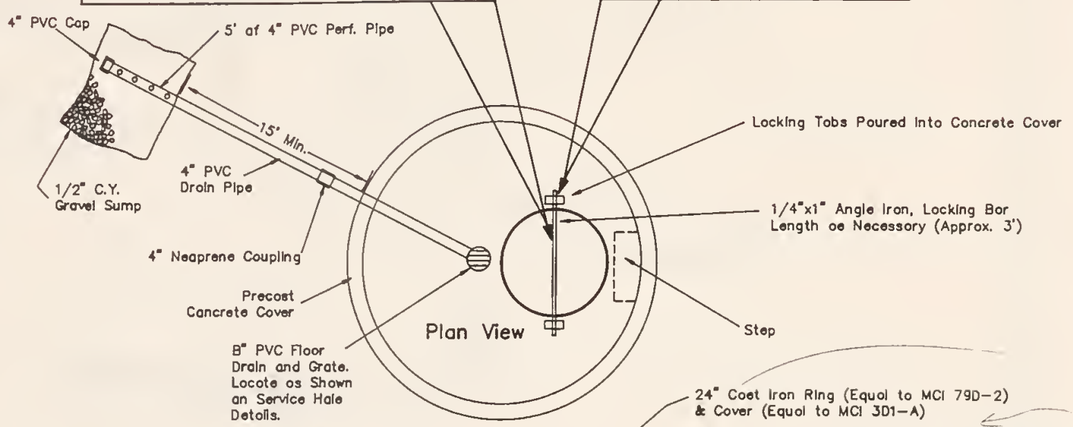
Locking Bar Detail

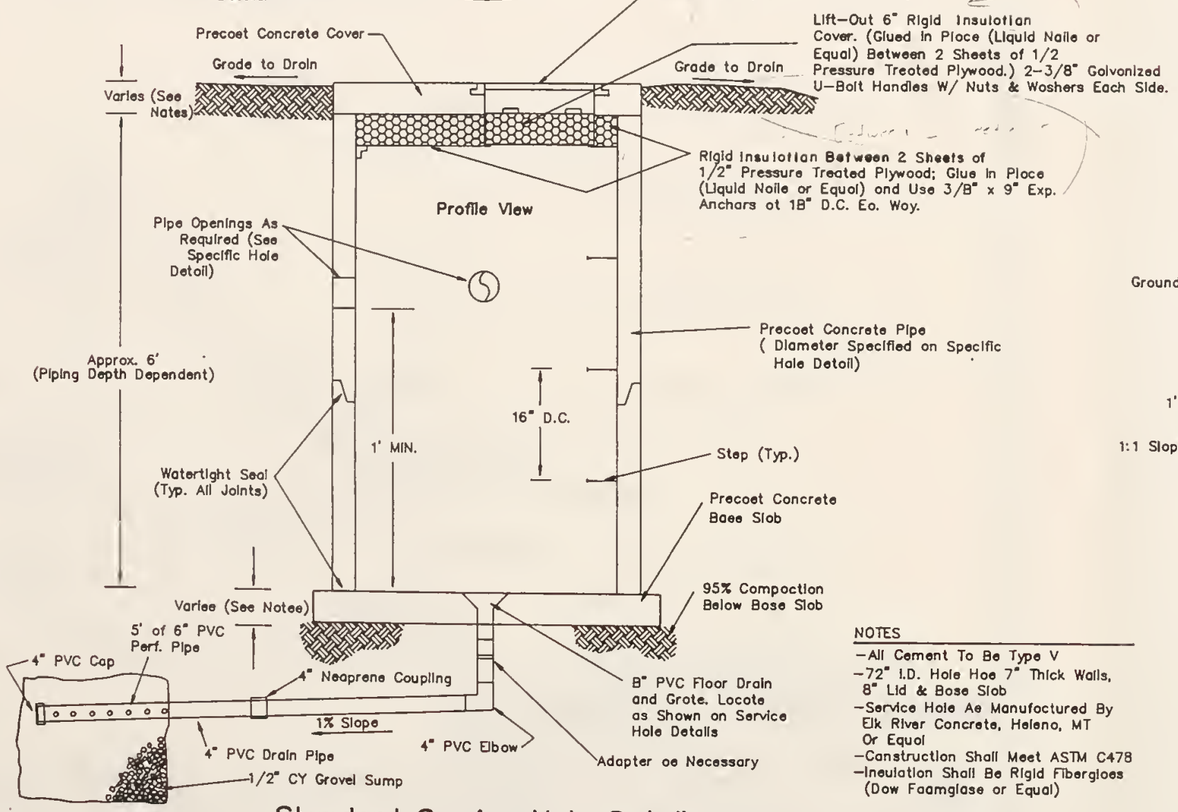


Tab Detail



RECORD DRAWING NOTE
– Locking Bar is flat iron not angle iron.

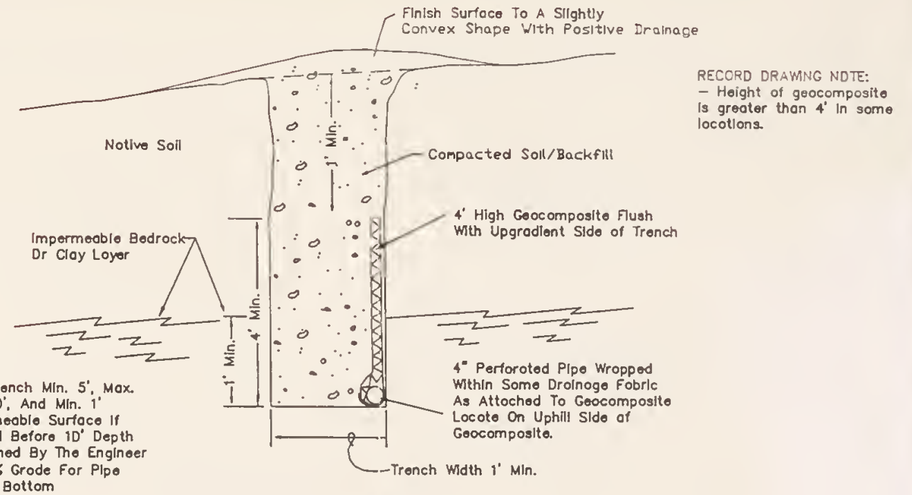

4" PVC Cap
5' of 4" PVC Perf. Pipe
15' Min.
4" PVC Drain Pipe
1/2" C.Y. Gravel Sump
4" Neaprene Coupling
Precast Concrete Cover
8" PVC Floor Drain and Grate. Locate as Shown on Service Hole Details.
Locking Tabs Poured Into Concrete Cover
1/4"x1" Angle Iron, Locking Bar Length as Necessary (Approx. 3')
Step
Plan View


24" Cast Iron Ring (Equal to MCI 79D–2) & Cover (Equal to MCI 3D1–A)
Lift–Out 6" Rigid Insulation Cover. (Glued in Place (Liquid Nails or Equal) Between 2 Sheets of 1/2 Pressure Treated Plywood.) 2–3/8" Galvanized U–Bolt Handles W/ Nuts & Washers Each Side.
Precast Concrete Cover
Grade to Drain
Grade to Drain
Varies (See Notes)
Rigid Insulation Between 2 Sheets of 1/2" Pressure Treated Plywood; Glue in Place (Liquid Nails or Equal) and Use 3/8" x 9" Exp. Anchors at 18" D.C. Eo. Way.
Profile View
Pipe Openings As Required (See Specific Hole Detail)
Precast Concrete Pipe (Diameter Specified on Specific Hole Detail)
Approx. 6' (Piping Depth Dependent)
16" D.C.
1' MIN.
Step (Typ.)
Watertight Seal (Typ. All Joints)
Precast Concrete Base Slab
95% Compaction Below Base Slab
Varies (See Notes)
5' of 6" PVC Perf. Pipe
4" PVC Cap
4" Neaprene Coupling
1% Slope
4" PVC Drain Pipe
4" PVC Elbow
8" PVC Floor Drain and Grate. Locate as Shown on Service Hole Details
Adapter as Necessary
1/2" CY Gravel Sump

NOTES
–All Cement To Be Type V
–72" I.D. Hole Hoe 7" Thick Walls, 8" Lid & Base Slab
–Service Hole As Manufactured By Elk River Concrete, Helena, MT Or Equal
–Construction Shall Meet ASTM C478
–Insulation Shall Be Rigid Fiberglass (Dow Foamglase or Equal)

Standard Service Hole Detail 5/5

Not to Scale


Finish Surface To A Slightly Convex Shape With Positive Drainage
Native Soil
3' Min.
Compacted Soil/Backfill
4' High Geocomposite Flush With Upgradient Side of Trench
Impermeable Bedrock Or Clay Layer
4' Min.
1' Min.
4" Perforated Pipe Wrapped Within Some Drainage Fabric As Attached To Geocomposite Locate On Uphill Side of Geocomposite.
Trench Width 1' Min.

RECORD DRAWING NOTE:
– Height of geocomposite is greater than 4' in some locations.

NOTE:
– Excavate Trench Min. 5', Max. Depth of 10', And Min. 1' Into Impermeable Surface If Encountered Before 10' Depth As Determined By The Engineer
–Minimum 1% Grade For Pipe And Trench Bottom
–See Detail ⊕

Interceptor Drain 7/5

Not to Scale

NOTE:
–Lime Subgrade Prior to Fabric Placement as Determined by Engineer
–Upstream and Downstream Ends of Mat To Be Keyed In Min. 12" Deep
–Grade For Positive Drainage

Riprap Lined Drainage Channel 6/5

Not to Scale

NOT USED (ALT. 1)

RECORD DRAWING 12/92

Project No. 91–001	Sheet Title: Miscellaneous Details
Date: May 1991	
Designed By: R. Morton	Project Title: Cascade Mine Drainage
Drawn By: S. Hathhorn	
Checked By: D. Widmayer	

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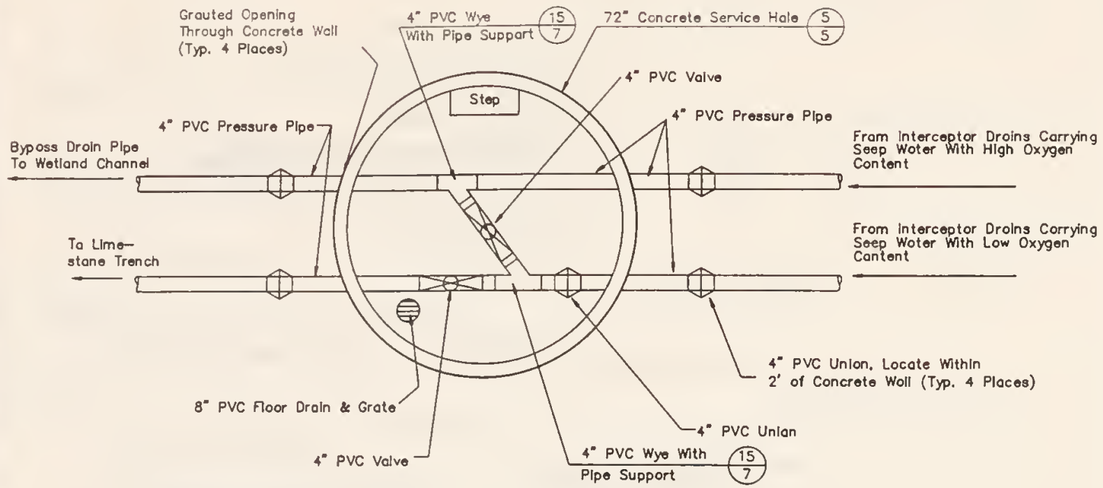
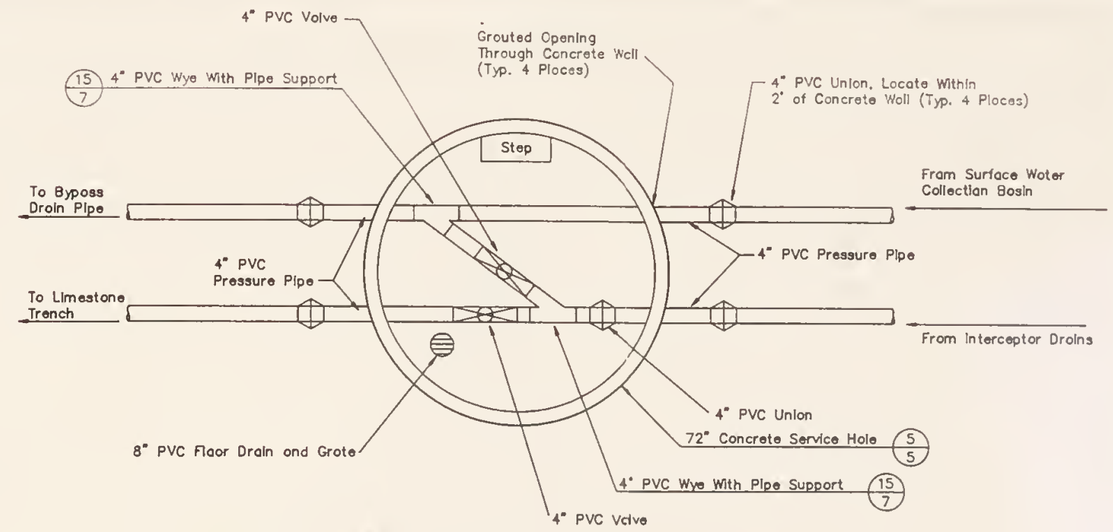
Sheet 5 of 12

·Robert Peccia & Associates · Helena, MT · RPA·



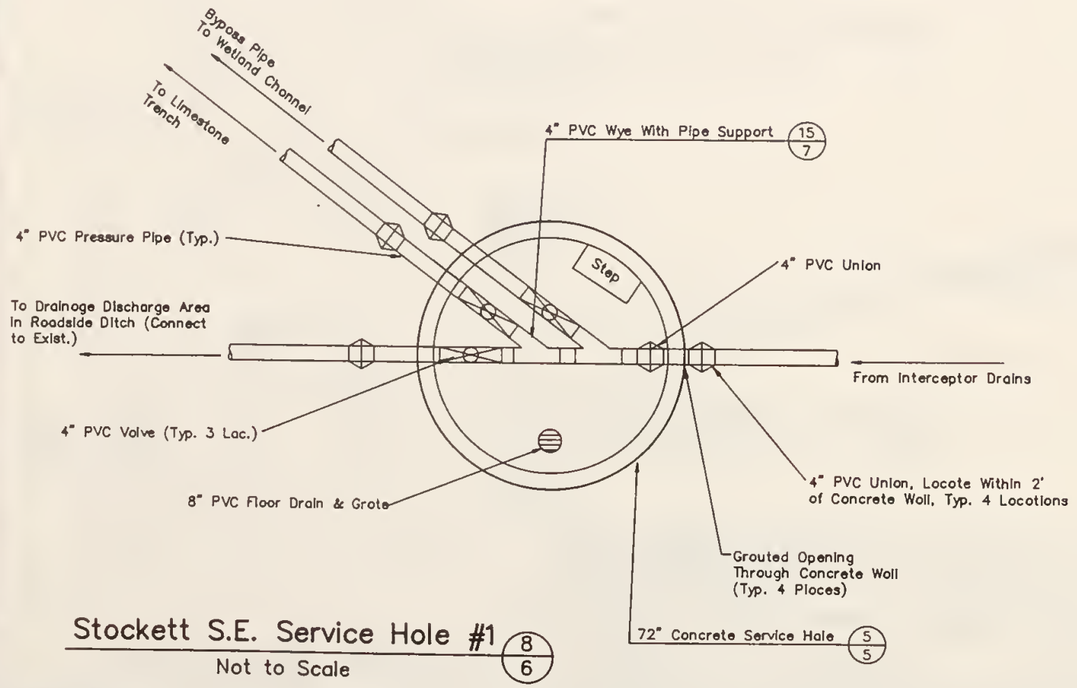
Stockett S.E. Service Hole #2 (9/6)

Not to Scale



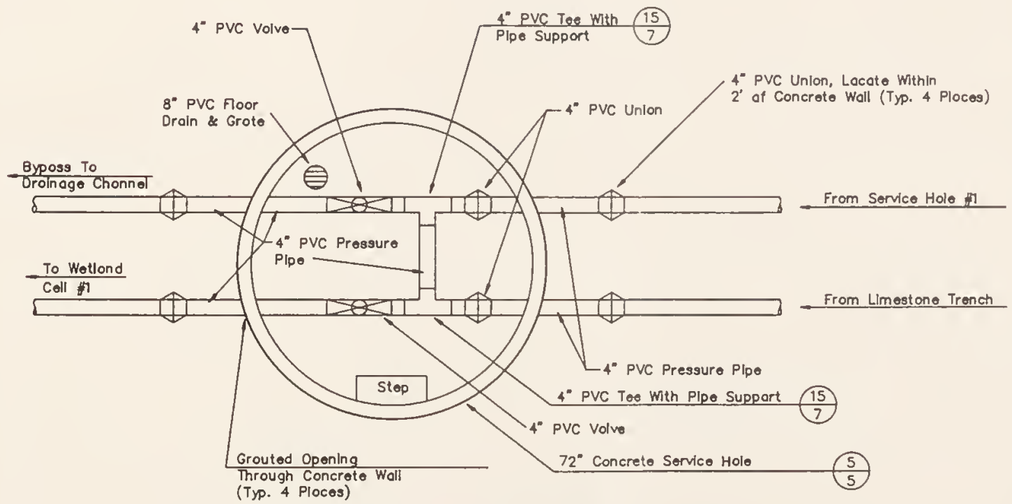
Centerville "C" Service Hole #1 (10/6)

Not to Scale



Stockett S.E. Service Hole #1 (8/6)

Not to Scale



Centerville "C" Service Hole #2 (11/6)

Not to Scale

RECORD DRAWING 12/92

RECORD DRAWING NOTE:
- See Operation and Maintenance Plan for additional Service Hole information.

Project No.: 91-001	Sheet Title: Miscellaneous Details
Date: May 1991	
Designed By: D.Widmayer	Project Title: Cascade Mine Drainage
Drawn By: S. Hathhorn	
Checked By: R. Morton	

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Sheet 6 of 12

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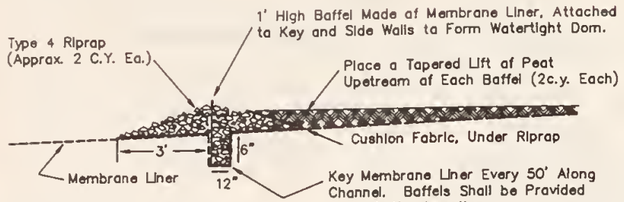
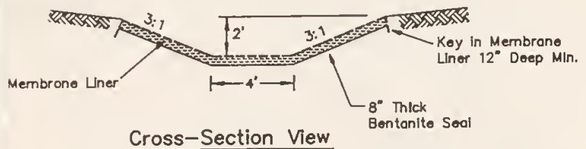

Type 4 Riprap
(Approx. 2 C.Y. Ea.)
1' High Baffel Made af Membrane Liner, Attached
ta Key and Side Walls ta Form Watertight Dam.
Place a Tapered Lift af Peat
Upetream af Each Baffel (2c.y. Each)
Cushion Fabric, Under Riprap
3'
6"
12"
Membrane Liner
Key Membrane Liner Every 50' Along
Channel. Baffels Shall be Pravided
at Each Key Lacatian.

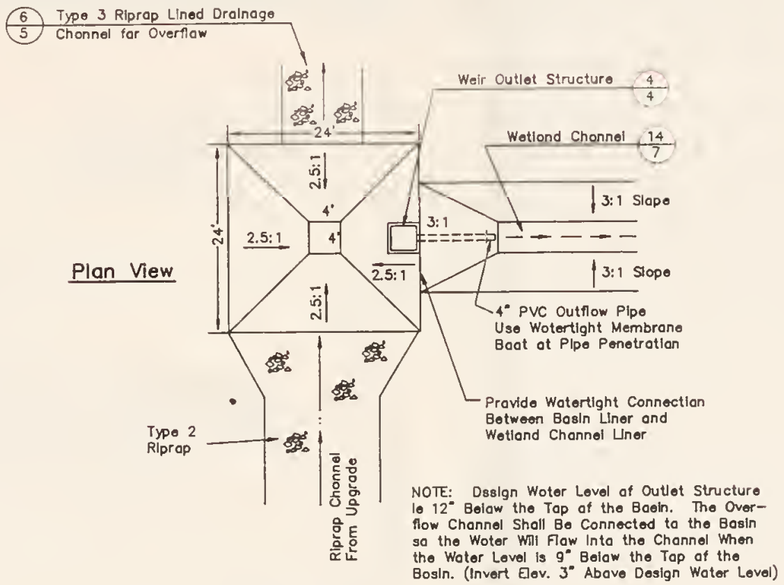
Profile View



Cross-Section View

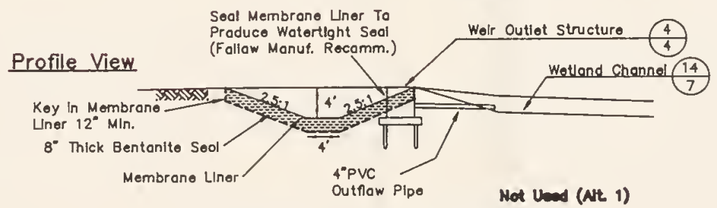
Wetland Channel (14/7)

Not to Scale



Plan View

NOTE: Dssign Water Level af Outlet Structure le 12" Belaw the Tap af the Baeln. The Overflow Channel Shall Be Connected ta the Basin sa the Water Will Flaw Inta the Channel When the Water Level is 9" Belaw the Tap af the Bosin. (Invert Elev. 3" Abave Design Water Level)



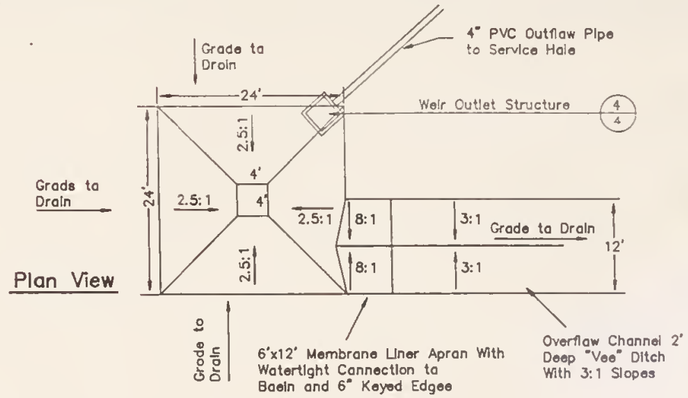
Profile View

Not Used (Alt. 1)

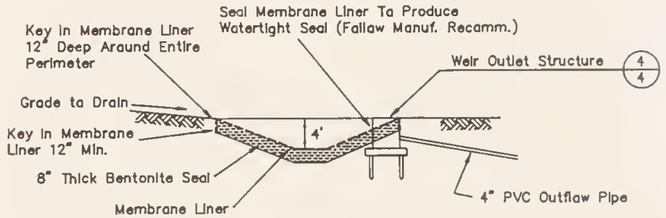
Membrane Lined Basin (17/7)

Stockette S.E.

Not to Scale



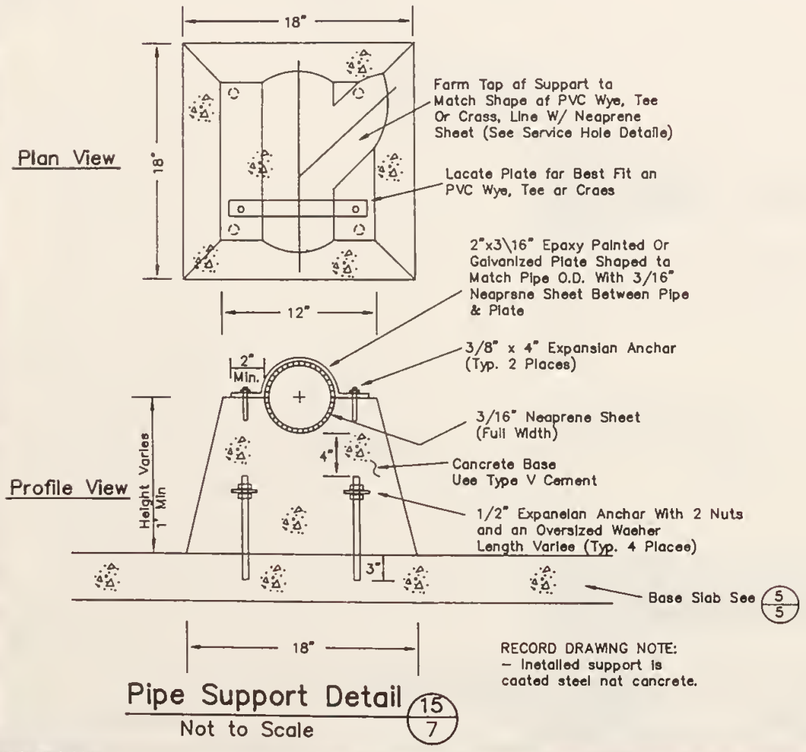
Plan View



Profile View

Surface Water Collection Basin (16/7)

Centerville "C" -Not to Scale



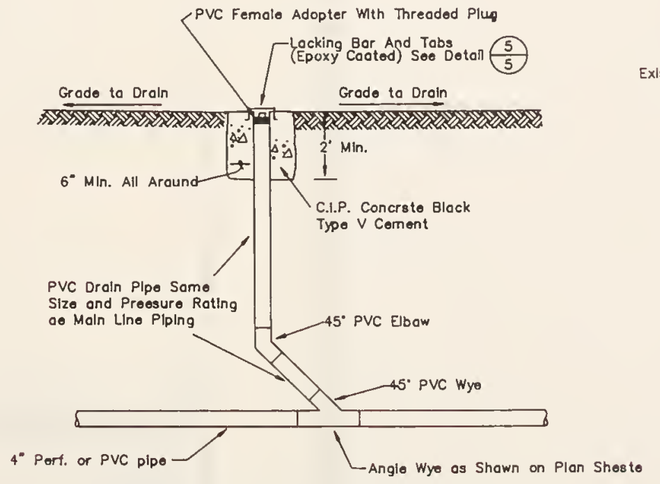
Plan View

Profile View

RECORD DRAWING NOTE:
- Installed support is coated steel not cancrete.

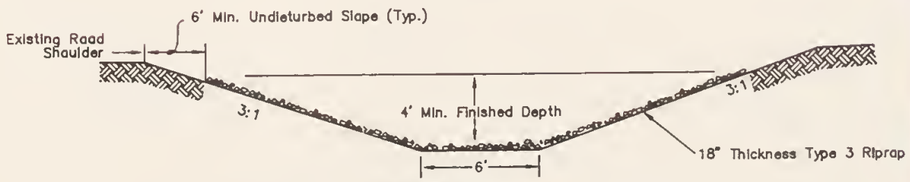
Pipe Support Detail (15/7)

Not to Scale



PVC Pipe Cleanout Detail (12/7)

Not to Scale



Not Used (Alt. 1)

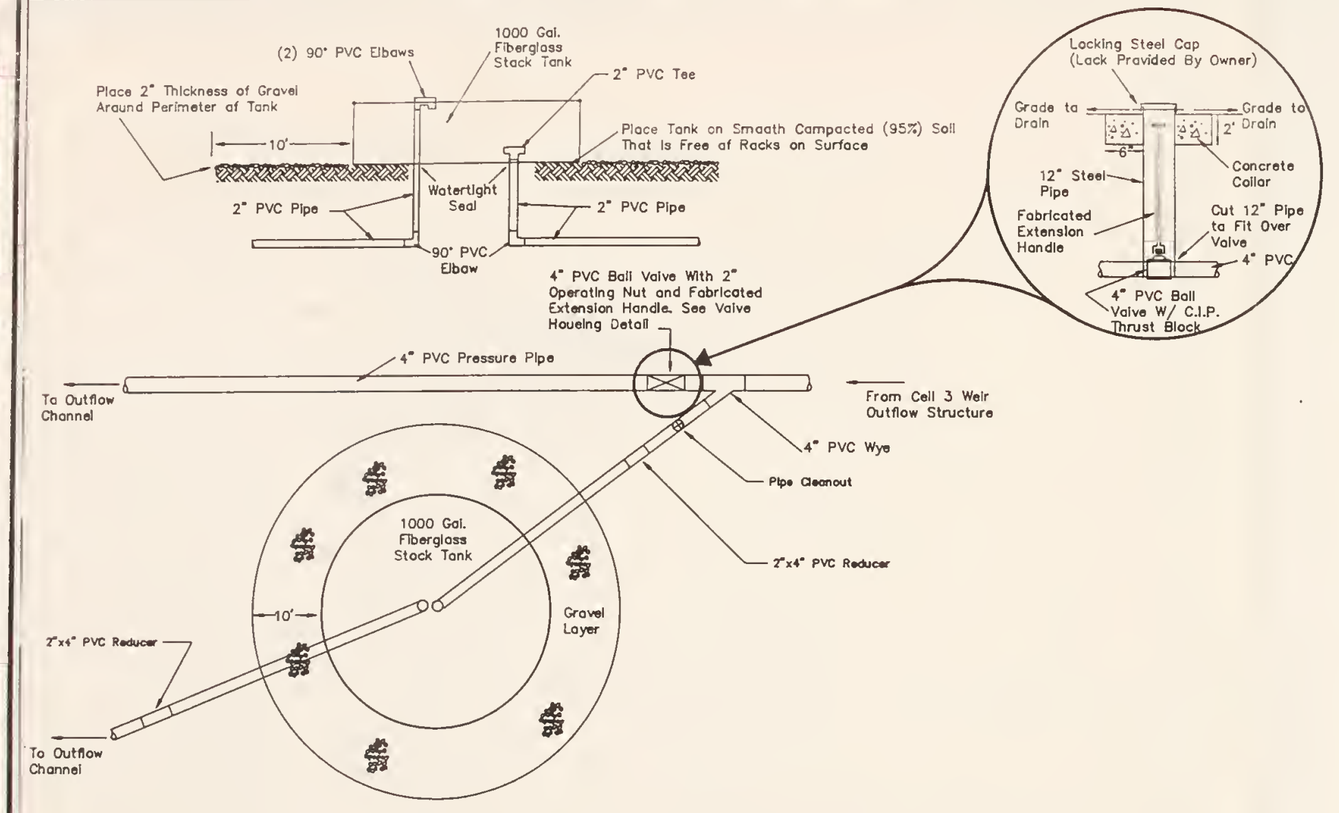
Reconstructed Roadside Ditch (13/7)

Not to Scale

RECORD DRAWING 12/92

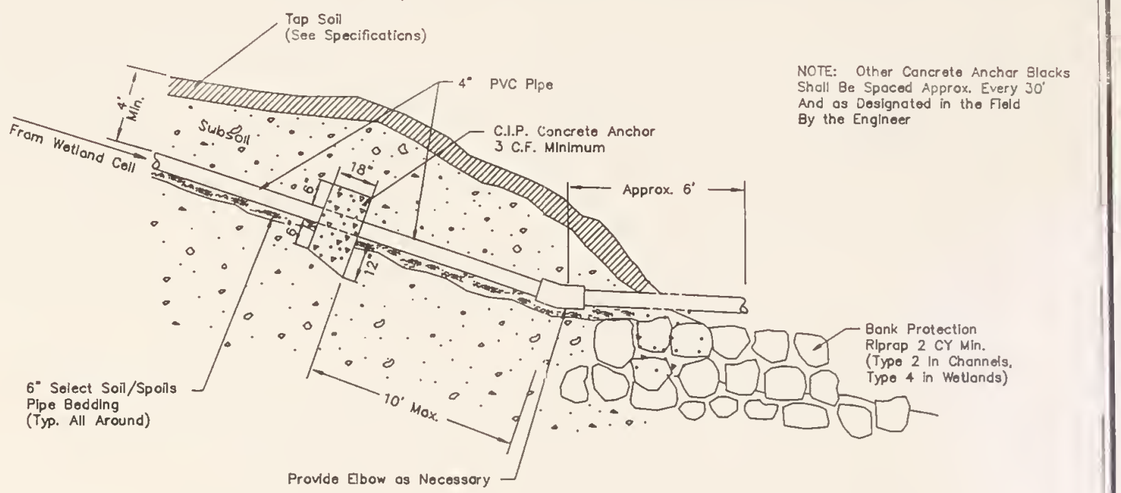
Project No.: 91-001	Sheet Title: Miscellaneous Details
Date: May 1991	7
Designed By: D. Widmayer	Project Title: Cascade Mine Drainage
Drawn By: S. Hathhorn	Sheet 7 of 12
Checked By: R. Morton	

·Robert Peccia & Associates · Helena, MT · RPA·


(2) 90° PVC Elbows
1000 Gal. Fiberglass Stack Tank
2" PVC Tee
Place 2" Thickness of Gravel Araund Perimeter af Tank
10'
Place Tank on Smaath Campacted (95%) Soil That Is Free af Racks on Surface
Watertight Seal
2" PVC Pipe
2" PVC Pipe
90° PVC Elbaw
4" PVC Ball Valve With 2" Operating Nut and Fabricated Extension Handle. See Valve Houeing Detail
Locking Steel Cap (Lack Pravided By Owner)
Grade ta Drain
Grade to 2" Drain
6"
Concrete Collar
12" Steel Pipe
Fabricated Extension Handle
Cut 12" Pipe ta Fit Over Valve
4" PVC
4" PVC Ball Valve W/ C.I.P. Thrust Block
4" PVC Pressure Pipe
To Outflow Channel
From Cell 3 Weir Outflow Structure
4" PVC Wye
Pipe Cleanout
2"x4" PVC Reducer
1000 Gal. Fiberglass Stock Tank
10'
Gravel Layer
2"x4" PVC Reducer
To Outflow Channel

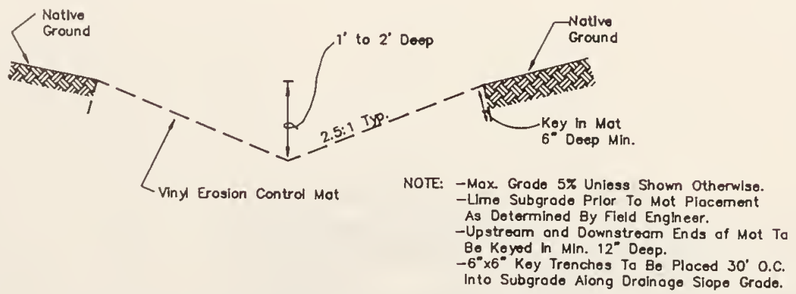
Stock Tank Piping Detail (19/8)

Not to Scale


Tap Soil (See Specifications)
4" Min.
4" PVC Pipe
NOTE: Other Concrete Anchar Blacks Shall Be Spaced Approx. Every 30' And as Designated in the Field By the Engineer
Subsoil
From Wetland Cell
C.I.P. Concrete Anchor 3 C.F. Minimum
18"
6"
6"
12"
Approx. 6'
Bank Protection Riprap 2 CY Min. (Type 2 In Channels, Type 4 in Wetlands)
6" Select Soil/Spoils Pipe Bedding (Typ. All Around)
10' Max.
Provide Elbow as Necessary

Drainage Outflow Structure (18/8)

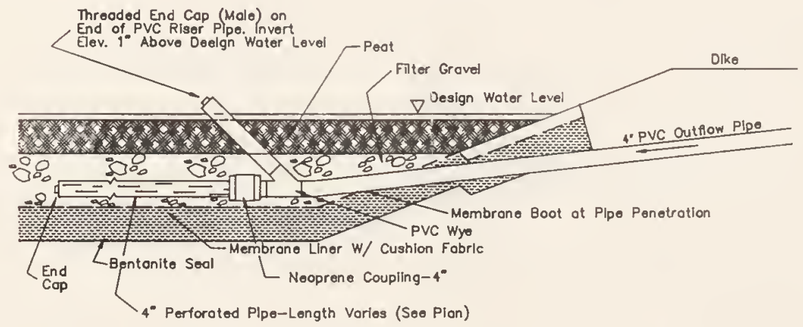
Not to Scale



NOTE:
- Max. Grade 5% Unless Shown Otherwise.
- Lime Subgrade Prior To Mat Placement As Determined By Field Engineer.
- Upstream and Downstream Ends af Mat Ta Be Keyed In Min. 12" Deep.
- 6"x6" Key Trenches Ta Be Placed 30' O.C. Into Subgrade Along Drainage Slope Grade.

Mat Lined Drainage Channel (20/8)

Not to Scale


Threaded End Cap (Male) on End of PVC Riser Pipe. Invert Elev. 1" Above Design Water Level
Peat
Filter Gravel
Dike
Design Water Level
4" PVC Outflow Pipe
Membrane Boot at Pipe Penetration
PVC Wye
Membrane Liner W/ Cushion Fabric
Bentanite Seal
Neoprene Coupling-4"
End Cap
4" Perforated Pipe-Length Varies (See Plan)

Perforated Pipe Inflow System (21/8)

Not to Scale

RECORD DRAWING 12/92

Project No.: 91-001	Sheet Title:
Date: May 1991	
Designed By: D. Widmayer	Project Title: Cascade Mine Drainage
Drawn By: S. Hathhorn	
Checked By: R.Morton	

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Sheet 8 of 12

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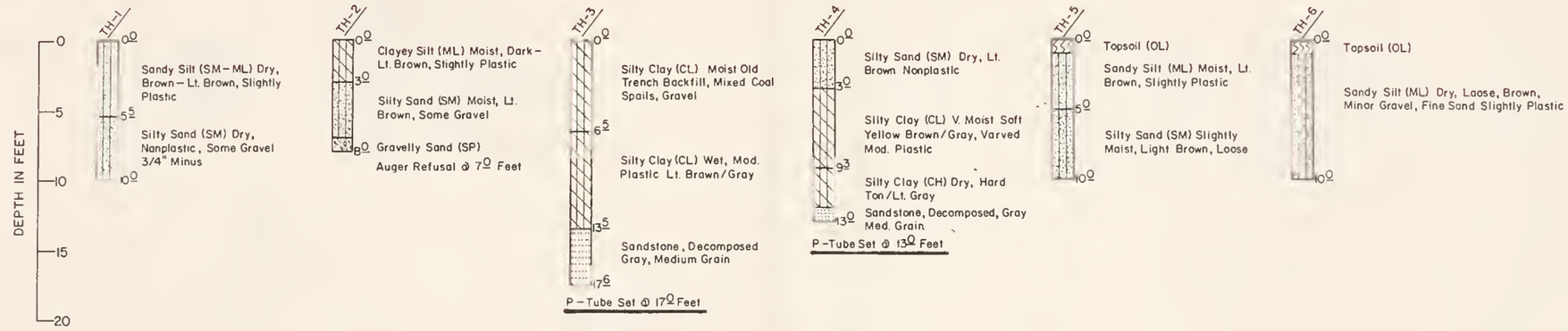


Centerville Soil Boring Test Holes (1/9)

Stockett Soil Boring Test Holes (2/9)

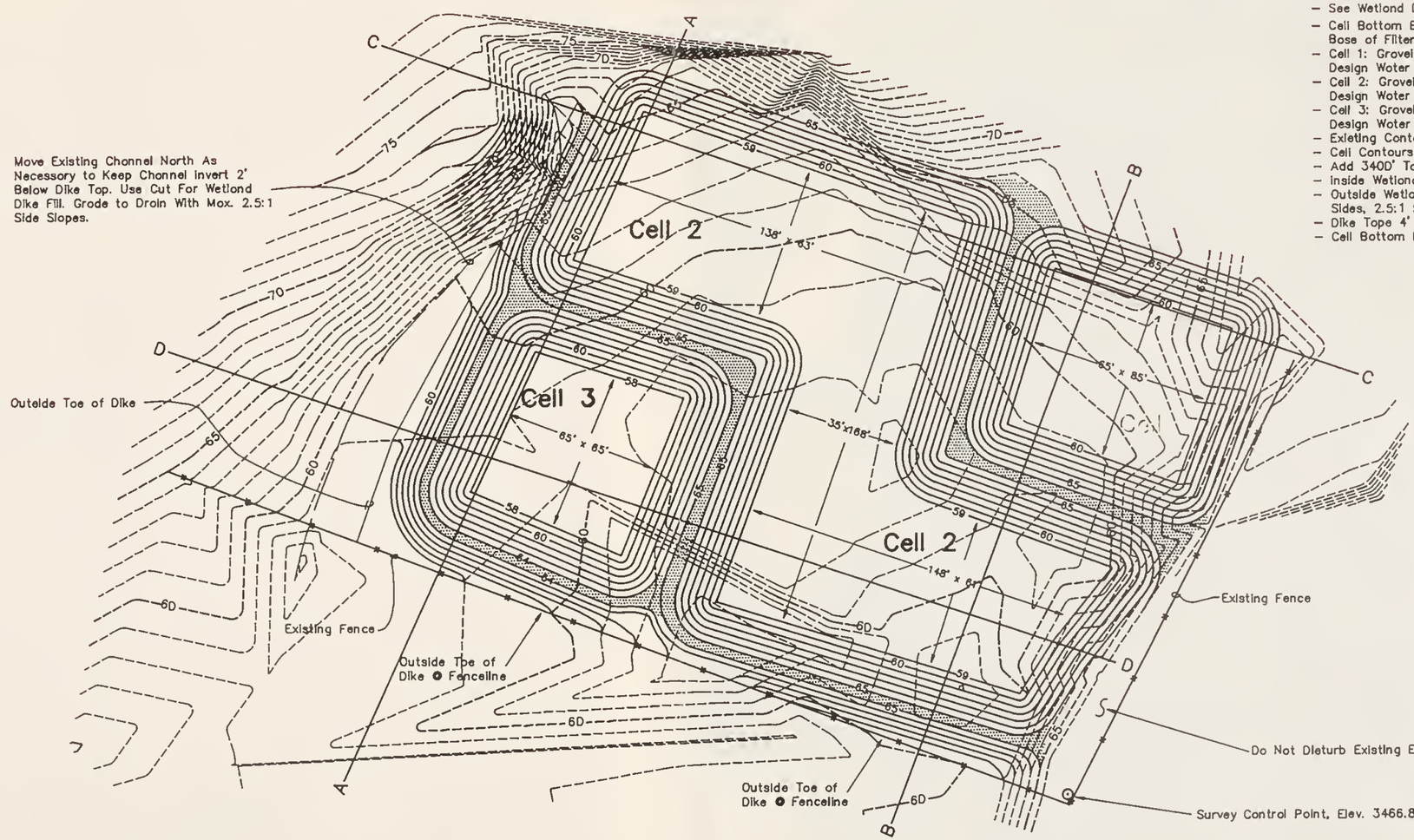
Record Drawing 12/92

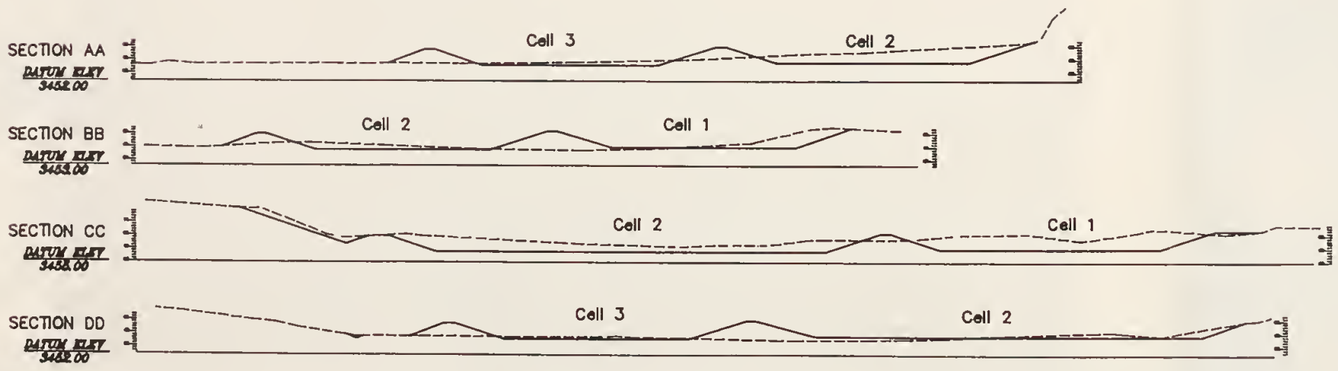
Project No.: 90-001	Sheet Title: SOIL BORING TEST HOLE DETAILS
Date: May, 1991	9
Designed By: D. Wells	Project Title: Cascade Mine Drainage
Drawn By: N. Ladas	Sheet 9 of 12
Checked By: B. Morton	

• Robert Peccia & Associates • Helena, MT • RPA •

NOTES

- See Wetland Dike Detail (2/4)
- Cell Bottom Elevations Shown are at Base of Filter Gravel
- Cell 1: Gravel 1.5' Thick, Peat 2.5' Thick, Design Water Level 64.5'
- Cell 2: Gravel 1.5' Thick, Peat 2.5' Thick, Design Water Level 63'
- Cell 3: Gravel 1.5' Thick, Peat 2' Thick, Design Water Level 61.5'
- Existing Contours ---------
- Cell Contours ———————
- Add 3400' To Get True Elevation
- Inside Wetland Dikes, 3:1 Slopes Typ.
- Outside Wetland Dikes, West & North Sides, 2.5:1 Slopes Typ.
- Dike Tops 4' Wide, Shaded
- Cell Bottom Dimensions Approximate


Move Existing Channel North As Necessary to Keep Channel Invert 2' Below Dike Top. Use Cut For Wetland Dike Fill. Grade to Drain With Max. 2.5:1 Side Slopes.
Outside Toe of Dike
Existing Fence
Outside Toe of Dike @ Fenceline
Cell 2
138' x 63'
Cell 3
85' x 65'
35'x168'
Cell 2
148' x 64'
65' x 85'
Existing Fence
Do Not Disturb Existing Elevation This End
Survey Control Point, Elev. 3466.80
Outside Toe of Dike @ Fenceline
A
B
C
D



RECORD DRAWING NOTE:
Cell bottom dimentions have been changed to field measured, cell contours have not been revised. This sheet replaces the orriginal sheet 10 of 12.

NORTH

D 15 30 60 90 feet

Scale: 1"=30'
Contour Interval: 1'

RECORD DRAWINGS 12/92

Project No.: 91-001	Sheet Title: CENTERVILLE "C" SITE Wetland Cell Earthwork & X-Section Detl. Change Order No. 1
Date: Sept., 1991	
Designed By: R. Morton	Project Title: Cascade Mine Drainage
Drawn By: S. Hathhorn	
Checked By: A. Beard	

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Sheet 10 of 12

NOTE: ⊕ See Wetland Dike Detail (12/4)

— Cell Bottom Elevation Shown Is At Base Of Filter Gravel

— For Additive Alternate 1 Work

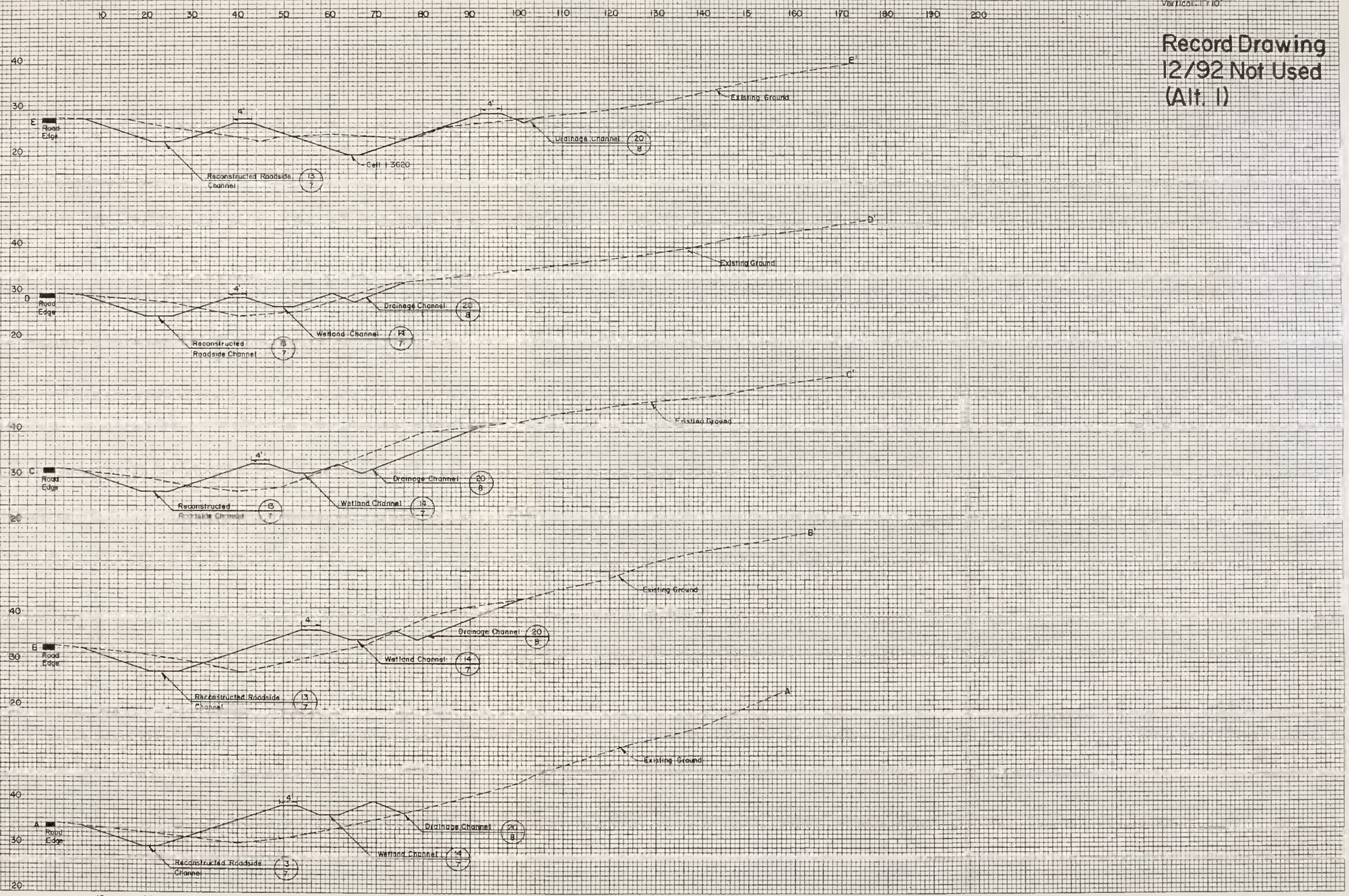
STOCKETT S.E.
CROSS SECTIONS

SCALE:
Horizontal: 1" = 10'
Vertical: 1" = 10'

Record Drawing 12/92 Not Used (Alt. 1)

FINAL SURVEY
NOTE BOOK
No.
DATE
BY
SURVEYED
PLOTTED
TEMPLATE
AREA
AREA CHECKED

ORIGINAL SURVEY
NOTE BOOK
No.
DATE
BY
SURVEYED
PLOTTED
TEMPLATE
AREA
AREA CHECKED



PLATTE CROSS SECTION O F R 420 STANDARD
DIETZGEN CORPORATION

NOTE: See Wetland Dike Detail (2/4)

- Cell Bottom Elev. Shown is at Base of Filter Gravel
- For Additive Alternate 1 Work

STOCKETT S.E. CROSS SECTION

SCALE:
Horizontal: 1" = 10'
Vertical: 1" = 10'

Record Drawing 12/92 Not Used (Alt. 1)

FINAL SURVEY — SURVEYED, PLOTTED, TEMPLATE, AREAS CHECKED, NOTE BOOK, NO., DATE, BY

ORIGINAL SURVEY — SURVEYED, PLOTTED, TEMPLATE, AREAS CHECKED, NOTE BOOK, NO., DATE, BY

Type 4 Riprap (approx. 170 CY)
Existing Ground
3624 (Typ Cell 1)
Wetland Dike and Anchor Trench (2/4) Typical
Wetland Channel (4/7)
Filter Gravel 1.5' Thick
Part 2' Thick
Cell 1 3620
Geotextile Inner Keyed In 2' Min. on All Edges. Piece Dimensions Approx. 22'x20'. Upper Elev. 6' Above Design W.L. Lower Key In At Interface of Riprap/Filter Gravel
N County Road
Reconstructed Roadside Channel (13/7)
Cell 1 3620 Thickness: Peat 2.0' Gravel 1.5'
Drainage Channel (20/8)
Existing Ground
S County Road
Reconstructed Roadside Channel (13/7)
Cell 1 3620 Thickness: Peat 2.0 Gravel 1.5'
Drainage Channel (20/8)
Existing Ground
R County Road
Reconstructed Roadside Channel (13/7)
Cell 1 3620 Thickness: Peat 2.0' Gravel 1.5'
Drainage Channel (20/8)
Existing Ground

10 20 30 40 50 60 70 80 90 100 110 120 130 140 150 160 170 180 190 200 210 220 230 240 250 260 270

PIPE DEPTHS BELOW GROUND SURFACE (B.G.S.)
AT EACH PIPE CLEANOUT ASSEMBLY

Stockett SE Site

Cleanout No.	Approximate Depth, B.G.S.	Block Found
1p	4'	NA
2s	4'	NA
3s	4'	NA
4s	4'	NA
5p	4'	85'
6s	4'	NA
7p	4'	NA
8s	4'	NA
9p	4'	65'
10s	4'	NA
11p	4'	62'
12s	5'	NA
13p	5'	NA
14s	5'	NA
15s	5'	NA
16s	5'	NA
17s	5'	NA
18s	5'	NA
19p	12'	NA
20p	10'	NA
21p	9'	86'
22p	8'	NA
23p	8'	NA
24p	8'	NA
25p	8'	NA
26p	9.5'	42.5'
27p	10'	12'
28p	7'	8'
29s	4'	NA
30s	5'	NA
31s	5'	NA
32p	7'	NA
33p	8'	NA
34p	10'	NA
35p	11'	NA
36p	13'	NA
37p	11'	NA
38c	13'	NA
39c	14'	68.5'
40p	12'	46'
41p	8'	NA
42p	8'	70'

s - solid pipe
p - perforated pipe
c - combination
NA- Not Applicable

PIPE DEPTHS BELOW GROUND SURFACE (B.G.S.)
AT EACH PIPE CLEANOUT ASSEMBLY

Stockett SE Site

Cleanout No.	Approximate Depth, B.G.S.	Block Found
43p	8′	NA
44p	8′	NA
45s	8′	NA
46p	9′	70′
47s	7′	NA
48p	7′	NA
49p	5′	NA
50p	7′	32′
51p	8′	28′
52p	7′	54′
53c	5′	NA
54p	9′	NA
55s	4′	NA
56s	4′	NA
57s	3′	NA
58p	9′	NA
59s	6′	NA
60s	8′	NA
61p	10′	NA

s - solid pipe
p - perforated pipe
c - combination
NA- Not Applicable

PIPE DEPTHS BELOW GROUND SURFACE (B.G.S.)
AT EACH PIPE CLEANOUT ASSEMBLY

Centerville "C" Site

Cleanout No.	Approximate Depth, B.G.S.	Block Found
1p	8′	NA
2p	9′	NA
3p	8′	NA
4p	8.5′	NA
5s	8′	NA
6s	8′	NA
7p	4′	NA
8p	4.5′	NA
9s	6′	NA
10p	4′	NA
11p	4′	NA
12p	4′	NA
13p	4′	NA
14p	7′	NA
15s	9′	NA
16s	10′	NA
17s	10′	NA
18s	6′	NA
19s	4′	NA
20s	4′	NA
21s	4′	NA
22s	4′	NA
23s	4′	NA
24s	2′	NA

s - solid pipe
p - perforated pipe
c - combination
NA- Not Applicable

Attachment H. Photographs/Slides

Only two copies of this final report were submitted with photographs and/or slides. Those copies reside with the Department of State Lands - Abandoned Mine Reclamation Bureau. A listing of the photograph/slide legend is provided below. Please contact the AMRB to obtain project photographs.

CASCADE MINE DRAINAGE PROJECT
PHOTOGRAPH/SLIDE LEGEND

Number	Date	Site Name	Description
1	8/1/91		Centerville C site: existing access culvert area prior to removing.
2	8/1/91		Centerville C site: existing access culvert area prior to removing.
3	8/1/91		Centerville C site: mobilizing equipment and materials.
4	8/1/91		Centerville C site: mobilizing equipment and materials.
5	8/1/91		Centerville C site: removing existing access culvert with backhoe and loader.
6	8/1/91		Centerville C site: existing wetland access prior to work.
7	8/1/91		Centerville C site: removing existing access culvert with backhoe and loader.
8	8/1/91		Centerville C site: removing existing access culvert with backhoe and loader.
9	8/07/91		Centerville C site: trench for interceptor drain #1 showing seeps in trench wall.
10	8/07/91		Centerville C site: trench for interceptor drain #1 showing seeps in trench wall.
11	8/07/91		Centerville C site: trench for interceptor drain #1 looking north towards existing 4" pipe. Note oxidized soils on trench wall.
12	8/07/91		Centerville C site: trench for interceptor drain #1 looking south. Note seepage in trench bottom.
13	8/07/91		Centerville C site: hole excavated to locate existing 4" pipe to tie in with interceptor drain #1.
14	8/08/91		Centerville C site: Placing geocomposite material for interceptor drain #1. The 2 x 4's are used to hold material in place against trench walls.
15	8/08/91		Centerville C site: Excavating trench for interceptor drain #1. Backhoe is filling trench with geocomposite material in place.
16	8/08/91		Centerville C site: Excavating trench for interceptor drain #1. Backhoe is filling trench with geocomposite material in place.
17	8/08/91		Centerville C site: Excavating trench for interceptor drain #1. Backhoe is backfilling trench with geocomposite material in place.
18	8/08/91		Centerville C site: interceptor drain #1 partially backfilled with geocomposite material in place.

CASCADE MINE DRAINAGE PROJECT
PHOTOGRAPH/SLIDE LEGEND

Number	Date	Site Name	Description
19	8/12/91		Centerville C site: placing geocomposite material with perforated pipe in interceptor drain #1.
20	8/12/91		Centerville C site: placing second layer of geocomposite material in trench for interceptor drain #1. The second tier was added to get more complete collection of acid seepage.
21	8/12/91		Centerville C site: partially backfilled interceptor drain #1. Looking north at one cleanout.
22	8/12/91		Centerville C site: looking north at partially backfilled interceptor drain #1.
23	8/12/91		Centerville C site: regraded slope above interceptor drain #1 looking south between last two cleanouts.
24	8/13/91		Centerville C site: excavating trench for interceptor drain #1.
25	8/13/91		Centerville C site: area prepared for excavation of interceptor drain #2.
26	8/13/91		Centerville C site: form placed in trench for bentonite seal to be poured at junction of perforated and PVC pipe in interceptor drain #1.
27	8/14/91		Centerville C site: temporary tie in with existing 4" pipe for interceptor drain #2.
28	8/14/91		Centerville C site: backfilling interceptor drain #2. Note seepage in trench bottom.
29	8/14/91		Centerville C site: acid mine drainage seeping from trench wall of interceptor drain #2. (Note clay horizon at base of trench.)
30	8/15/91		Centerville C site: cleanout installed in interceptor drain #2.
31	8/15/91		Centerville C site: backfilling interceptor drain #2.
32	8/15/91		Centerville C site: close up of cleanout installed in perforated pipe in interceptor drain #2.
33	8/15/91		Centerville C site: unloading manholes with crane. Manhole weighed approximately 17,000 pounds.
34	8/19/91		Centerville C site: looking west from interceptor drain #3 towards cleared and grubbed wetland cells.
35	8/19/91		Centerville C site: prepared area for excavating interceptor drain #3.

CASCADE MINE DRAINAGE PROJECT
PHOTOGRAPH/SLIDE LEGEND

Number	Date	Site Name	Description
36	8/19/91		Centerville C site: placing service hole #1.
37	8/19/91		Centerville C site: placing service hole #1.
38	8/19/91		Centerville C site: Existing 4" pipe when cut to place tie in for interceptor drain #3. Approximately 20 gpm flowed from pipe. This water was backed up in the existing 4" pipe due to clogging in the pipe.
39	8/19/91		Centerville C site: Existing 4" pipe when cut to place tie in for interceptor drain #3. Approximately 20 gpm flowed from pipe. This water was backed up in the existing 4" pipe due to clogging in the pipe.
40	8/20/91		Centerville C site: water flowing from wall of trench for interceptor drain #3 near existing 4" pipe due to backed up water in pipe.
41	8/20/91		Centerville C site: water flowing from wall of trench for interceptor drain #3 near existing 4" pipe due to backed up water in pipe.
42	8/20/91		Centerville C site: cleaning existing 4" pipe using water jet.
43	8/20/91		Centerville C site: cleaning existing 4" pipe using water jet. Pipe flowed full for approximately 90 seconds then dissipated to 5 gpm.
44	8/20/91		Centerville C site: flow in existing 4" pipe after cleaning with water jet.
45	8/20/91		Centerville C site: looking west from interceptor drain #3 towards cleared and grubbed wetland cells. Note service hole #1 in place and cleared and grubbed area for bypass line.
46	8/21/91		Centerville C site: excavating trench for interceptor drain #3. Fill is being hauled around to the backhoe for use in backfilling the trench.
47	8/21/91		Centerville C site: double cleanout installed in existing 4" pipe above interceptor drain #1. There were no cleanouts in the existing pipe.
48	8/21/91		Centerville C site: looking west from interceptor drain #3 towards cleared and grubbed wetland cells. Note service hole #1 in place and initiation of excavation for bypass line.
49	8/21/91		Centerville C site: form for bentonite seal in interceptor drain #3.
50	8/21/91		Centerville C site: view from west of highway (at mouth of Heal Coulee) looking east at Centerville C site.

CASCADE MINE DRAINAGE PROJECT
PHOTOGRAPH/SLIDE LEGEND

Number	Date	Site Name	Description
51	8/22/91		Centerville C site: French drain intercepted during excavation of interceptor drain #3. The drain is located approximately 60 ft from the existing 4" pipe and runs downslope, perpendicular to interceptor drain #3. The perforated pipe in the French drain was not flowing.
52	8/22/91		Centerville C site: French drain intercepted during excavation of interceptor drain #3. The drain is located approximately 60 ft from the existing 4" pipe and runs downslope, perpendicular to interceptor drain #3. The perforated pipe in the French drain was not flowing.
53	8/22/91		Centerville C site: French drain intercepted during excavation of interceptor drain #3. The drain is located approximately 60 ft from the existing 4" pipe and runs downslope, perpendicular to interceptor drain #3. The perforated pipe in the French drain was not flowing.
54	8/22/91		Centerville C site: French drain intercepted during excavation of interceptor drain #3. The drain is located approximately 60 ft from the existing 4" pipe and runs downslope, perpendicular to interceptor drain #3. The perforated pipe in the French drain was not flowing.
55	8/22/91		Centerville C site: geocomposite material placed across French drain in interceptor drain #3.
56	8/22/91		Centerville C site: partially backfilled interceptor drain #3. Note triple tiered fabric at end of trench.
57	8/22/91		Centerville C site: area prepared for excavation of trench for interceptor drain #4.
58	8/22/91		Centerville C site: area prepared for excavation of trench for interceptor drain #4.
59	8/27/91		Stockett S.E.: mobilization to site and access entry preparation.
60	8/29/91		Stockett S.E.: west slope excavation for interceptor drain and connection to existing 4" PVC.
61	8/29/91		Stockett S.E.: west slope exposed previous french drain near adit, repaired.
62	8/29/91		Stockett S.E.: west slope excavation for interceptor drain and connection to existing 4" PVC.
63	8/29/91		Stockett S.E.: west slope excavation for interceptor drain and connection to existing 4" PVC.
64	9/3/91		Stockett S.E.: west slope excavation for interceptor drain with Case 980, near cleanout #40.

CASCADE MINE DRAINAGE PROJECT
PHOTOGRAPH/SLIDE LEGEND

Number	Date	Site Name	Description
65	9/3/91		Stockett S.E.: west slope interceptor drain installation and backfill with loader, near cleanout #40.
66	9/3/91		Stockett S.E.: west slope interceptor drain installation, near cleanout #40, checking grade. Note wire attached to board and geocomposite to hold in place.
67	9/3/91		Stockett S.E.: west slope interceptor drain installation, near cleanout #40, seeps within layers of clay soils.
68	9/10/91		Stockett S.E.: north west slope grading preparation for trenching of interceptor drain.
69	9/10/91		Stockett S.E.: north west slope grading preparation for trenching of interceptor drain.
70	9/10/91		Stockett S.E.: north west slope existing seeps.
71	9/10/91		Stockett S.E.: north west slope existing seeps.
72	9/10/91		Stockett S.E.: north west slope existing seeps.
73	9/10/91		Stockett S.E.: north west slope existing seeps.
74	9/10/91		Stockett S.E.: north west slope existing seeps.
75	9/10/91		Stockett S.E.: north slope existing seeps.
76	9/10/91		Stockett S.E.: north slope existing seeps.
77	9/10/91		Stockett S.E.: north east slope existing seeps.
78	9/10/91		Stockett S.E.: north east slope existing seeps.
79	9/10/91		Stockett S.E.: east slope existing seeps.
80	9/10/91		Stockett S.E.: east slope existing seeps.
81	9/10/91		Stockett S.E.: south east slope existing seeps.
82	9/10/91		Stockett S.E.: south east slope existing seeps.
83	9/10/91		Stockett S.E.: east slope existing access road.
84	9/10/91		Stockett S.E.: south east coulee prior to work.

CASCADE MINE DRAINAGE PROJECT
PHOTOGRAPH/SLIDE LEGEND

Number	Date	Site Name	Description
85	9/10/91		Stockett S.E.: south end of site looking north.
86	9/10/91		Stockett S.E.: overview of south west end of site.
87	9/10/91		Stockett S.E.: overview of north west end of site.
88	9/10/91		Stockett S.E.: overview of south west end of site.
89	9/10/91		Stockett S.E.: overview of north west end of site.
90	9/10/91		Stockett S.E.: overview of north west end of site.
91	9/10/91		Stockett S.E.: overview of north slope existing seeps.
92	9/10/91		Stockett S.E.: overview of north west slope existing seeps.
93	9/10/91		Stockett S.E.: overview of north west slope existing seeps.
94	9/10/91		Stockett S.E.: overview of north east slope existing seeps.
95	9/10/91		Stockett S.E.: overview of north east slope existing seeps.
96	9/10/91		Stockett S.E.: overview of north east slope existing seeps.
97	9/10/91		Stockett S.E.: overview of south east slope existing seeps.
98	9/10/91		Stockett S.E.: overview of south east end of site and south east coulee.
99	9/11/91		Coversoil Borrow area: test holes.
100	9/11/91		Coversoil Borrow area: test holes.
101	9/11/91		Coversoil Borrow area: test holes.
102	9/11/91		Coversoil Borrow area: test holes.
103	9/11/91		Coversoil Borrow area: test holes.
104	9/11/91		Coversoil Borrow area: site overview, agricultural field.
105	9/11/91		Coversoil Borrow area: site overview, agricultural field.
106	9/11/91		Coversoil Borrow area: site overview, agricultural field.
107	9/11/91		Coversoil Borrow area: site overview, agricultural field.

CASCADE MINE DRAINAGE PROJECT
PHOTOGRAPH/SLIDE LEGEND

Number	Date	Site Name	Description
108	9/11/91		Coversoil Borrow area: site overview, agricultural field.
109	9/11/91		Coversoil Borrow area: site overview, agricultural field.
110	9/17/91		Stockett S.E.: south east coulee trench for interceptor drain.
111	9/17/91		Stockett S.E.: south east coulee trench for interceptor drain.
112	9/17/91		Stockett S.E.: south east coulee trench for interceptor drain.
113	9/17/91		Stockett S.E.: at south east coulee looking north, grade preparation for excavation. of interceptor drain.
114	9/17/91		Stockett S.E.: installing SW service hole with crane.
115	9/17/91		Stockett S.E.: SW service hole, to date installation of valves and couplings.
116	9/18/91		Stockett S.E.: east slope interceptor drain installation, water in trench.
117	9/18/91		Stockett S.E.: east slope interceptor drain installation, water in trench.
118	9/18/91		Stockett S.E.: east slope interceptor drain installation, water in trench.
119	9/18/91		Stockett S.E.: east slope interceptor drain installation, site overview looking north.
120	9/18/91		Stockett S.E.: east slope interceptor drain installation, site overview looking north.
121	9/19/91		Stockett S.E.: west slope site overview.
122	9/24/91		Stockett S.E.: south east coulee, view from below, landowner fencing in foreground.
123	9/24/91		Stockett S.E.: east slope view from below.
124	9/24/91		Stockett S.E.: east slope view from below.
125	9/24/91		Stockett S.E.: north east slope view from below.
126	9/24/91		Stockett S.E.: north slope view from below.
127	9/24/91		Stockett S.E.: west slope overview.

CASCADE MINE DRAINAGE PROJECT
PHOTOGRAPH/SLIDE LEGEND

Number	Date	Site Name	Description
128	9/25/91		Centerville C site: applying bentonite to soil for preparation of premix soil/bentonite seal used for ends of interceptor drains and limestone trenches.
129	10/15/91		Centerville C site: wetland construction, scraper building up dike.
130	10/15/91		Centerville C site: wetland construction, scraper building up dike.
131	10/15/91		Centerville C site: wetland construction, grader working dike, D7 helping borrow fill material on north slope.
132	10/15/91		Centerville C site: wetland construction cell 1, tractor and compactor.
133	10/15/91		Centerville C site: wetland construction, grader working dike of cells 2 & 3, backhoe helping.
134	10/15/91		Centerville C site: D7 helping borrow fill material on north slope.
135	10/15/91		Centerville C site: wetland construction cell 1, tractor and compactor.
136	10/15/91		Centerville C site: wetland construction, grader working dike of cells 2 & 3.
137	10/15/91		Centerville C site: wetland construction, grader working dike of cells 2 & 3, freshly watered cell 2 for dust control.
138	11/13/91		Centerville C site: 1 of 3 panorama, wetland construction north end, loader moving coversoil.
139	11/13/91		Centerville C site: 2 of 3 panorama, wetland construction cells 2 & 3, fine grading with JD 555, motorgrader and D7. Case 980 excavating for pipe from limestone trench to service hole
140	11/13/91		Centerville C site: 3 of 3 panorama, wetland construction cells 1 & 2.
141	11/14/91		Stockett S.E.: south west end lime application by hand.
142	11/20/91		Centerville C site: upper area north of existing 4"PVC line, trench excavation for additional interceptor drain, little indication of seepage.
143	11/20/91		Centerville C site: cell 1 hand application and incorporation of bentonite with tiller attachment to tractor.
144	11/20/91		Centerville C site: cell 1 bentonite incorporation, cells 2 & 3 placement of weir outlet structures.

CASCADE MINE DRAINAGE PROJECT
PHOTOGRAPH/SLIDE LEGEND

Number	Date	Site Name	Description
145	11/20/91		Centerville C site: upper area north of existing 4"PVC line, trench excavation for additional interceptor drain, Case 980 excavator.
146	3/6/92		Stockett S.E.: access junction near entrance and lime stockpile.
147	3/6/92		Stockett S.E.: outlet of SW pipe in road ditch.
148	3/6/92		Stockett S.E.: west limestone trench with survey control point on left side of photo.
149	3/6/92		Stockett S.E.: west limestone trench, looking south, Marko house in upper right of photo.
150	3/6/92		Stockett S.E.: future location of west wetland channel.
151	3/6/92		Stockett S.E.: future location of west wetland channel.
152	3/6/92		Stockett S.E.: future location of west wetland channel.
153	3/6/92		Stockett S.E.: future location of west wetland channel and junction with north wetland channel.
154	3/6/92		Stockett S.E.: future location of west wetland channel outlet.
155	3/6/92		Stockett S.E.: slope below future location of west wetland channel.
156	3/6/92		Stockett S.E.: future location of west wetland channel.
157	3/17/92		Centerville C site: wetland cell 2 compaction of bentonite seal.
158	3/17/92		Centerville C site: wetland cell 2 compaction of bentonite seal, closeup shows slope hump.
159	3/17/92		Centerville C site: wetland cell 2 pipe trenching and installation.
160	3/17/92		Centerville C site: wetland cell 2 pipe trenching and installation.
161	3/17/92		Centerville C site: wetland cell 2 pipe trenching and installation. Hand lime application on hill in background.
162	3/17/92		Centerville C site: applying lime by hand on upper slope, NE corner.
163	3/18/92		Centerville C site: compacting bentonite seal in wetland cell 2, wet conditions, tiller equipment for mixing bentonite and soil in background.

CASCADE MINE DRAINAGE PROJECT
PHOTOGRAPH/SLIDE LEGEND

Number	Date	Site Name	Description
164	3/18/92		Centerville C site: lime incorporation and shaping with D7 cat at steep area #1, workers waiting for lime load behind Cat.
165	3/18/92		Centerville C site: steep area #1, using loader to deliver lime, placement and application by hand, backhoe incorporation of lime above.
166	3/23/92		Centerville C site: weekend precipitation created puddles in cells, required additional spreading/mixing in cell bottoms prior to compaction.
167	3/23/92		Centerville C site: premixing soil/bentonite seal with grader.
168	3/23/92		Centerville C site: premixing soil/bentonite seal with grader, loader helping and placing in premix pile left of loader. Manure and filter gravel stockpiles in background.
169	3/30/92		Stockett S.E.: shaping west wetland channel with JD 450.
170	3/30/92		Stockett S.E.: shaping west wetland channel with JD 510, spoils from north wetland channel in background.
171	3/30/92		Stockett S.E.: start of shaping north wetland channel, outlet end.
172	3/30/92		Stockett S.E.: start of shaping north wetland channel.
173	3/30/92		Stockett S.E.: NW limestone trench, forms and piping.
174	3/31/92		Stockett S.E.: west wetland channel bentonite soil seal incorporation.
175	3/31/92		Stockett S.E.: north wetland channel shaping and filling low spots with JD 450 and JD 555.
176	3/31/92		Centerville C site: start of excavation of surface water collection basin, bypass piping on right, wetland basins and coversoil stockpiles in background, service hole and limestone trench on left.
177	3/31/92		Centerville C site: cleaning out liner key trenches and cleaning basin bottom for liner preparation.
178	4/1/92		Centerville C site: cell 2 preparing cell bottom by spreading fine and thin layer of soil/bentonite mix to fill in voids > 1".
179	4/1/92		Centerville C site: cell 2 key trench, compacting soils around weir outlet structure.

CASCADE MINE DRAINAGE PROJECT
PHOTOGRAPH/SLIDE LEGEND

Number	Date	Site Name	Description
180	4/1/92		Stockett S.E.: west wetland channel after bentonite incorporation and before compaction, lots of rock picking needed.
181	4/1/92		Stockett S.E.: west wetland channel after bentonite incorporation and before compaction, looking north.
182	4/1/92		Stockett S.E.: north wetland channel bentonite application.
183	4/1/92		Centerville C site: start of liner installation cell 2.
184	4/1/92		Centerville C site: liner seaming.
185	4/2/92		Stockett S.E.: bentonite incorporation north wetland channel.
186	4/2/92		Centerville C site: liner attachment to weir outlet structure.
187	4/2/92		Centerville C site: liner attachment to weir outlet structure.
188	4/2/92		Centerville C site: start of gravel placement on cushion fabric, cell 1, built gravel ramp at centralized cell access location.
189	4/3/92		Centerville C site: cell 2 and 3 after liner placement and before cushion fabric placement.
190	4/3/92		Centerville C site: cell 2 start of cushion fabric placement.
191	4/3/92		Centerville C site: cell 1 gravel placement, visitors in black.
192	4/3/92		Centerville C site: limestone trench placement of cushion fabric prior to liner.
193	4/3/92		Centerville C site: limestone trench placement of cushion fabric prior to liner, lots of watchers.
194	4/3/92		Centerville C site: limestone trench liner placement by liner crew.
195	4/3/92		Stockett S.E.: west wetland channel excavating key trenches at baffle locations.
196	4/3/92		Stockett S.E.: using ditch witches to dig key trenches at wetland channels, west channel outlet foreground, north channel outlet background.
197	4/3/92		Stockett S.E.: west wetland channel baffle key trench, rough and prior to additional placement of bentonite/soil seal.
198	4/3/92		Centerville C site: liner crew using available space at Centerville to prefabricate liner for limestone trenches.

CASCADE MINE DRAINAGE PROJECT
PHOTOGRAPH/SLIDE LEGEND

Number	Date	Site Name	Description
199	4/4/92		Centerville C site: start of gravel placement in cell 2, built gravel ramp at centralized cell access location.
200	4/6/92		Stockett S.E.: west wetland channel compaction of bentonite/soil seal.
201	4/6/92		Stockett S.E.: excavating for repair of blocked pipe near SE coulee.
202	4/6/92		Stockett S.E.: SW limestone trench with liner and cushion fabric, west wetland channel in background.
203	4/7/92		Stockett S.E.: west wetland channel starting to place hypalon liner.
204	4/7/92		Stockett S.E.: west wetland channel just prior to liner placement. Note bags of gravel used to hold baffle key from collapse during forklift access.
205	4/7/92		Stockett S.E.: north wetland channel preparation for liner placement, key trench and basin cleaning.
206	4/7/92		Stockett S.E.: north wetland channel preparation for liner placement, key trenching with ditch witch.
207	4/7/92		Stockett S.E.: west wetland channel starting to place hypalon liner.
208	4/8/92		Stockett S.E.: north wetland channel preparation for liner placement, key trenching with JD 510 helping hold ditch witch from sliding.
209	4/8/92		Stockett S.E.: north wetland channel preparation for liner placement, key trenching with JD 510 helping hold ditch witch from sliding.
210	4/8/92		Stockett S.E.: north wetland channel preparation for liner placement, key trenching with JD 510 helping hold ditch witch from sliding, worker standing in rough baffle key trench.
211	4/8/92		Stockett S.E.: north wetland channel preparation for liner placement, filling over excavated baffle key trenches with premix of bentonite/soil then hand compacting and shaping.
212	4/9/92		Stockett S.E.: north wetland channel at telephone interceptor outlet prior to liner placement.
213	4/9/92		Stockett S.E.: north wetland channel at telephone interceptor outlet prior to liner placement.

CASCADE MINE DRAINAGE PROJECT
PHOTOGRAPH/SLIDE LEGEND

Number	Date	Site Name	Description
214	4/9/92		Stockett S.E.: north wetland channel, lay out of liner. Note bags used for weighing down liner in case of wind. Filter gravel in bags was later used as riprap.
215	4/9/92		Stockett S.E.: north wetland channel, lay out of liner.
216	4/13/92		Centerville C site: perforated pipe placement in wetland cell.
217	4/13/92		Centerville C site: limestone aggregate placement in limestone trench.
218	4/14/92		Centerville C site: limestone aggregate placement in limestone trench.
219	4/14/92		Stockett S.E.: trench above telephone pole interceptor prior to PVC pipe placement.
220	4/14/92		Stockett S.E.: site overview at trench above telephone pole interceptor during PVC pipe placement.
221	4/14/92		Stockett S.E.: site overview at north end of site. Note stockpiled coversoil.
222	4/14/92		Stockett S.E.: site overview at north end of site.
223	4/14/92		Stockett S.E.: NW limestone trench, installing limestone aggregate.
224	4/14/92		Stockett S.E.: limestone trench common problem, tears of liner corners, patched later.
225	4/14/92		Stockett S.E.: backfilling of telephone trench interceptor.
226	4/15/92		Centerville C site: site overview, stockpiles, park, highschool.
227	4/15/92		Centerville C site: site overview, stockpiles, water truck, park.
228	4/15/92		Centerville C site: site overview, stockpiles, loader, park, start of peat placement in cell 1. Note gravel ramp and peat spilled.
229	4/15/92		Centerville C site: site overview, stockpiles, loaders, town, start of peat placement in cell 1. Note gravel ramp in cell 2 and loader tracks on peat.
230	4/15/92		Centerville C site: site overview, loader, JD 450, final grading of gravel in cell 2. Note gravel ramp in cell 2, lower left.
231	4/15/92		Centerville C site: site overview, north slope and outlet channel.
232	4/15/92		Stockett S.E.: west wetland channel, hypalon liner in place.

CASCADE MINE DRAINAGE PROJECT
PHOTOGRAPH/SLIDE LEGEND

Number	Date	Site Name	Description
233	4/15/92		Stockett S.E.: limestone trench corner tear in liner later patched, gap between liner and plywood form was later filled with bentonite/soil mix.
234	4/15/92		Stockett S.E.: limestone trench closeup of corner tear in liner.
235	4/15/92		Stockett S.E.: SW limestone trench, S end, corner problems required re-excavation and repair.
236	4/15/92		Stockett S.E.: SW limestone trench, S end, corner problems required re-excavation and repair.
237	4/16/92		Stockett S.E.: intersection of interceptor drains, downgradient crossover to match source water oxygen concentrations.
238	4/16/92		Stockett S.E.: intersection of interceptor drains, upgradient crossover to match source water oxygen concentrations.
239	4/21/92		Stockett S.E.: north channel looking northeast during placement of riprap dikes.
240	4/21/92		Stockett S.E.: 1 of 5 panorama of west side from south end to north end.
241	4/21/92		Stockett S.E.: 2 of 5 panorama of west side from south end to north end.
242	4/21/92		Stockett S.E.: 3 of 5 panorama of west side from south end to north end. JD 555 hauling riprap.
243	4/21/92		Stockett S.E.: 4 of 5 panorama of west side from south end to north end.
244	4/21/92		Stockett S.E.: 5 of 5 panorama of west side from south end to north end.
245	4/22/92		Centerville C site: Newly found hand close adit, before.
246	4/22/92		Centerville C site: Newly found hand close adit, during.
247	4/22/92		Centerville C site: Newly found hand close adit, after.
248	4/22/92		Centerville C site: looking west at site from top of knoll. Note cell 1 with hay bale dikes and cell 3 placing Peat-DCW. Limestone drain in center of photo.
249	4/22/92		Centerville C site: 1 of 4 panorama from south to north overlooking access road to wetland and ball park. Coversoil and manure stockpiles. Truck hauling Peat-DCW.
250	4/22/92		Centerville C site: 2 of 4 panorama from south to north overlooking cell 1 with hay bale dikes in place and manhole 1.

CASCADE MINE DRAINAGE PROJECT
PHOTOGRAPH/SLIDE LEGEND

Number	Date	Site Name	Description
251	4/22/92		Centerville C site: 3 of 4 panorama from south to north cell 2 with gravel in place and cell 3 peat-DPW being placed. Note JD 450 fine grading peat.
252	4/22/92		Centerville C site: 4 of 4 panorama from south to north overlooking north end of project. JD 450 on gravel ramp into cell 3.
253	4/24/92		Cell 2 + Cell 3. Centerville C site: peat-OM being mixed in cell 2 with loader.
254	4/24/92		Centerville C site: peat-OM consisting of straw, limestone aggregate and manure in cell 2.
255	4/24/92		Centerville C site: cell 1 after being filled with fresh water.
256	4/27/92		Centerville C site: placing straw with loader for peat-OM mix in north end of Cell 2.
257	4/27/92		Centerville C site: culvert in place in north channel.
258	4/27/92		Centerville C site: staking hay bale dikes in cell 3.
259	4/28/92		Centerville C site: auger drilling post holes for fence on north end.
260	4/28/92		Centerville C site: mixing peat-OM with JD 450 in cell 2.
261	4/28/92		Centerville C site: channel on Marko's property, west of site. Note salvaged 12" PVC pipe.
262	4/28/92		Centerville C site: looking west from cell 3 at Marko's channel. Note stock tank prior to installation.
263	4/28/92		Centerville C site: graded channel on Marko's property. Looking southeast towards wetland.
264	4/28/92		Centerville C site: looking east from Marko's property toward east slope.
265	4/28/92		Centerville C site: looking west at grade of channel on Marko's property.
266	4/28/92		Centerville C site: graded area for stock tank placement.
267	4/28/93		Centerville C site: 1 of 2 panorama of wetland cells. JD 450 mixing peat-OM.
268	4/28/92		Centerville C site: 2 of 2 panorama of wetland cells. Loader placing coversoil along cell 2 dike.
269	4/30/92		Centerville C site: straw supply from Chartier property.

CASCADE MINE DRAINAGE PROJECT
PHOTOGRAPH/SLIDE LEGEND

Number	Date	Site Name	Description
270	5/01/92		Centerville C site: unloading trees for Centerville Park.
271	5/01/92		Centerville C site: sprinkling water on cattails at cell 1.
272	5/01/92		Centerville C site: planting cattails in cell 3.
273	5/01/92		Centerville C site: planting cattails in cell 3.
274	5/01/92		Centerville C site: planting cattails in cell 3.
275	5/01/92		Centerville C site: closeup of cattails and best shovel type.
276	5/01/92		Centerville C site: excavation for transplanting trees.
277	5/01/92		Centerville C site: transplanting trees.
278	5/04/92		Centerville C site: 1 of 4 panorama of wetland cells from south to north.
279	5/04/92		Centerville C site: 2 of 4 panorama of wetland cells from south to north.
280	5/04/92		Centerville C site: 3 of 4 panorama of wetland cells from south to north.
281	5/04/92		Centerville C site: 4 of 4 panorama of wetland cells from south to north.
282	5/05/92		Centerville C site: fresh water from cell 3 released into Marko's channel making grading difficult.
283	5/05/92		Centerville C site: excavated material from Marko's channel to correct grade. Water in channel made final grading very difficult.
284	5/05/92		Centerville C site: water in Marko's channel made final grading difficult.
285	5/05/92		Centerville C site: regrading Marko channel to correct grade.
286	5/05/92		Centerville C site: regrading Marko channel to correct grade.
287	5/05/92		Centerville C site: placing/mixing peat-OM in cell 2 with JD 450.
288	5/06/92		Stockett S.E.: incorporating lime with disk on east side of site.
289	5/06/92		Stockett S.E.: limed area in southeast coulee.
290	5/06/92		Stockett S.E.: covering NE limestone trench.
291	5/06/92		Stockett S.E.: covering NE limestone trench.

CASCADE MINE DRAINAGE PROJECT
PHOTOGRAPH/SLIDE LEGEND

Number	Date	Site Name	Description
292	5/13/92		Centerville C site: 1 of 5 panorama from south to north, fuel truck.
293	5/13/92		Centerville C site: 2 of 5 panorama from south to north, loader, trees in park.
294	5/13/92		Centerville C site: 3 of 5 panorama from south to north, loader, cells 1 and 2.
295	5/13/92		Centerville C site: 4 of 5 panorama from south to north, cells 2 and 3.
296	5/13/92		Centerville C site: 5 of 5 panorama from south to north, cell 2, loader placing coversoil on north slope.
297	5/13/92		Centerville C site: grading west side of wetland dikes.
298	5/13/92		Centerville C site: west side wetland, moving coversoil.
299	5/13/92		Centerville C site: north channel final grade, grading west side wetland dikes.
300	5/13/92		Centerville C site: north channel and placing coversoil on north slope.
301	5/13/92		Centerville C site: grade on west side of wetland dikes.
302	5/13/92		Centerville C site: grading west side of wetland dikes and placing coversoil on north slope.
303	5/13/92		Stockett S.E.: north wetland channel peat placement.
304	5/13/92		Stockett S.E.: north wetland channel peat placement.
305	5/14/92		Stockett S.E.: cleanout # 39 leaking again.
306	5/19/92		Stockett S.E.: repair of southwest interceptor drain found to be plugged and was backed-up and leaking from cleanout #39 up gradient.
307	5/19/92		Stockett S.E.: repair of southwest interceptor drain. Excavation of old trench to expose geocomposite and pipe.
308	5/19/92		Stockett S.E.: repair of southwest interceptor drain. Excavation of old trench to expose geocomposite and pipe.
309	5/19/92		Stockett S.E.: leaking cleanout indicating a plugged interceptor drain.
310	5/19/92		Stockett S.E.: leaking cleanout indicating a plugged interceptor drain.
311	5/19/92		Stockett S.E.: SE limestone trench ready to be covered, bypass line installation on right.

CASCADE MINE DRAINAGE PROJECT
PHOTOGRAPH/SLIDE LEGEND

Number	Date	Site Name	Description
312	5/19/92		Stockett S.E.: exposed geocomposite in southwest interceptor drain. (Note seeping wall not covered by geocomposite.)
313	5/20/92		Stockett S.E.: partially crushed perforated pipe found while trying to tie new interceptor drain into existing pipe.
314	5/20/92		Stockett S.E.: partially crushed perforated pipe found while trying to tie new interceptor drain into existing pipe.
315	5/20/92		Stockett S.E.: geocomposite in place at tie-in for new interceptor drain.
316	5/20/92		Stockett S.E.: geocomposite in place at tie-in for new interceptor drain.
317	5/20/92		Stockett S.E.: excavating trench for new interceptor drain.
318	5/20/92		Stockett S.E.: new interceptor drain installed at seep on north end of project; shows exposed trench wall.
319	5/20/92		Stockett S.E.: backfilling new interceptor drain (3 tiers of geocomposite).
320	5/20/92		Stockett S.E.: SW limestone trench after being graded.
321	5/20/92		Stockett S.E.: SW limestone trench outlet to south wetland channel.
322	5/20/92		Stockett S.E.: west wetland channel looking north. Shows wetland cells filled with peat and limestone aggregate and riprap dikes.
323	5/20/92		Stockett S.E.: SW manhole after grading.
324	5/20/92		Stockett S.E.: liming slope on south west end where interceptor drain was replaced due to crushed pipe.
325	5/21/92		Stockett S.E.: adit #1 after closure.
326	5/21/92		Stockett S.E.: adit #1 showing opening which needs further closure.
327	5/21/92		Stockett S.E.: adit #1 after closure looking north.
328	5/26/92		Stockett S.E.: geocomposite and perforated pipe prefabrication and installation.
329	5/26/92		Stockett S.E.: geocomposite and perforated pipe prefabrication and installation.
330	5/26/92		Stockett S.E.: trench excavation for additional interceptor drain on lower north hill.

CASCADE MINE DRAINAGE PROJECT
PHOTOGRAPH/SLIDE LEGEND

Number	Date	Site Name	Description
331	5/26/92		Stockett S.E.: trench excavation for additional interceptor drain on lower north hill.
332	5/26/92		Stockett S.E.: sewer snaking at cleanout # 57.
333	5/26/92		Stockett S.E.: two precipitate type extracted during snaking of cleanout # 57.
334	5/26/92		Stockett S.E.: west side outlet pipe in road ditch.
335	5/26/92		Stockett S.E.: west side outlet pipe in road ditch.
336	5/26/92		Stockett S.E.: west side outlet pipe in road ditch after removal of elbow.
337	5/26/92		Stockett S.E.: trench at tie in location of additional north interceptor drain.
338	5/26/92		Stockett S.E.: installation of geocomposite at additional north interceptor drain.
339	5/26/92		Stockett S.E.: installation of geocomposite at additional north interceptor drain.
340	5/26/92		Stockett S.E.: installation of geocomposite at additional north interceptor drain.
341	5/26/92		Stockett S.E.: installation of geocomposite at additional north interceptor drain.
342	5/26/92		Stockett S.E.: installation of geocomposite at additional north interceptor drain.
343	5/28/92		Stockett S.E.: installation of geocomposite at additional north interceptor drain, repairing overnight and 5/27/92 weather day collapsed trench.
344	5/28/92		Stockett S.E.: installation of geocomposite at additional north interceptor drain, repairing overnight collapsed trench.
345	5/28/92		Stockett S.E.: down gradient of SW service hole, cause of plug evident from cleanout # 57, replaced with straight pipe.
346	5/28/92		Stockett S.E.: down gradient of SW service hole, cause of plug evident from cleanout # 57, replaced with straight pipe. Note precipitate in pipe.
347	5/28/92		Stockett S.E.: start of excavation to find plug in interceptor drain at SE coulee.
348	5/28/92		Stockett S.E.: start of excavation to find plug in interceptor drain at SE coulee.
349	5/28/92		Stockett S.E.: exposed geocomposite in interceptor drain at SE coulee.
350	5/28/92		Stockett S.E.: closeup of sewer snake end on left and sewer tape end on right.

CASCADE MINE DRAINAGE PROJECT
PHOTOGRAPH/SLIDE LEGEND

Number	Date	Site Name	Description
351	6/01/92		Stockett S.E.: removing spoils pile at confluence of north and south wetland channels.
352	6/01/92		Stockett S.E.: north wetland channel filled with sediment from recent rains, flow bypass line shown.
353	6/01/92		Stockett S.E.: north wetland channel filled with sediment from recent rains.
354	6/01/92		Stockett S.E.: north wetland channel near telephone pole showing side slope slumped into channel after recent rain and plugged bypass pipeline.
355	6/01/92		Stockett S.E.: north wetland channel showing lime after incorporated by hand on far bank.
356	6/02/92		Stockett S.E.: view of cleanout #11 prior to replacement of perforated pipe in interceptor drain.
357	6/02/92		Stockett S.E.: excavation near cleanout #11 to expose interceptor drain.
358	6/02/92		Stockett S.E.: top of existing geocomposite exposed near cleanout #11.
359	6/02/92		Stockett S.E.: crushed perforated pipe being cut out and replaced.
360	6/02/92		Stockett S.E.: perforated pipe and geocomposite replaced near cleanout #11; ready for backfill.
361	6/02/92		Stockett S.E.: area near cleanout #11 after replacement and backfill.
362	6/02/92		Stockett S.E.: geocomposite and PVC pipe near cleanout #9 being exposed for repair and replacement of perforated pipe. Shovel tip is on perforated pipe.
363	6/02/92		Stockett S.E.: crushed perforated pipe exposed and being removed and replaced near cleanout #9. Clay clod backfill likely culprit.
364	6/03/92		Stockett S.E.: crushed perforated pipe exposed and being removed and replaced near cleanout #9.
365	6/03/92		Stockett S.E.: close up of crushed pipe replaced near cleanout #9.
366	6/03/92		Stockett S.E.: close up of crushed pipe replaced near cleanout #9.
367	6/03/92		Stockett S.E.: uncovering section of crushed perforated pipe by hand at cleanout #9. Adjacent solid PVC line is from the SE Coulee interceptor drain source.

CASCADE MINE DRAINAGE PROJECT
PHOTOGRAPH/SLIDE LEGEND

Number	Date	Site Name	Description
368	6/03/92		Stockett S.E.: removing section of crushed perforated pipe near cleanout #9. (Note how geocomposite is cut to expose perforated pipe.)
369	6/03/92		Stockett S.E.: removing section of crushed perforated pipe near cleanout #9. (Note how geocomposite is cut to expose perforated pipe.)
370	6/03/92		Stockett S.E.: placing geocomposite patch around replaced section of crushed perforated pipe near cleanout #9. (Note replaced perforated pipe is black.)
371	6/03/92		Stockett S.E.: placing geocomposite patch around replaced section of crushed perforated pipe near cleanout #9. (Note replaced perforated pipe is black.)
372	6/03/92		Stockett S.E.: adit #1 after second attempt to close.
373	6/03/92		Stockett S.E.: adit #1 after all openings adequately closed.
374	6/03/92		Centerville C site: 1 of 2 panorama of site from north to south. Shows stilling basin filled with water and sediment. Sediment was removed later.
375	6/03/92		Centerville C site: 2 of 2 panorama of site from north to south. Shows cell 3 and most of cell 2.
376	6/04/92		Stockett S.E.: cutting geocomposite material to expose crushed perforated pipe near cleanout #27.
377	6/04/92		Stockett S.E.: exposed section of crushed perforated pipe near cleanout #27. (Note geocomposite in place along trench wall.)
378	6/04/92		Stockett S.E.: crushed sections of perforated pipe (2' and 5') replaced near cleanout #7. Backfill method and type suspect in crushing problem.
379	6/04/92		Stockett S.E.: showing perforated pipe prior to replacing crushed section to check for additional blockage. Additional blockage found approximately 30 feet down gradient.
380	6/04/92		Stockett S.E.: placing geocomposite patch around replaced perforated pipe (black).
381	6/04/92		Stockett S.E.: backfilling replaced section of interceptor drain near cleanout #27.
382	6/04/92		Stockett S.E.: placing geocomposite patch around replaced perforated pipe (2') near cleanout #28.
383	6/04/92		Centerville C site: JD 555 with rippers lowered preparing to go down steep east slope to incorporate lime.

CASCADE MINE DRAINAGE PROJECT
PHOTOGRAPH/SLIDE LEGEND

Number	Date	Site Name	Description
384	6/04/92		Centerville C site: JD 555 ripping east slope to incorporate lime.
385	6/04/92		Centerville C site: JD 555 ripping east slope to incorporate lime.
386	6/04/92		Centerville C site: east slope after one pass with rippers. Slope was ripped again to better incorporate lime.
387	6/04/92		Centerville C site: terrace on east slope (location of interceptor drain #3) after liming and prior to final grading.
388	6/08/92		Centerville C site: cattails in cell 3 (planted 5/01/92) showing poor cattail growth compared to cell 1.
389	6/08/92		Centerville C site: cattails in cell 3 (planted 5/01/92). Floating green scum on surface.
390	6/08/92		Centerville C site: cattails in cell 1 (planted 5/01/92) showing good cattail growth (green tops) compared to cell 3.
391	6/08/92		Stockett S.E.: exposed geocomposite and perforated pipe near cleanout #27.
392	6/08/92		Stockett S.E.: inserting sewer tape in pipe to check for additional blockage prior to replacing crushed perforated pipe.
393	6/08/92		Stockett S.E.: crushed perforated pipe removed from interceptor drain near cleanout #27.
394	6/08/92		Stockett S.E.: crushed perforated pipe removed from interceptor drain near cleanout #27. Clay clods and rock backfill culprit.
395	6/08/92		Stockett S.E.: excavating second location near cleanout #28.
396	6/08/92		Stockett S.E.: exposed crushed perforated pipe prior to removal near cleanout #28.
397	6/08/92		Stockett S.E.: excavating a second location near cleanout #27.
398	6/08/92		Stockett S.E.: exposed crushed perforated pipe prior to removal at second location near cleanout #27.
399	6/08/92		Stockett S.E.: close up of crushed perforated pipe from previous photo.
400	6/08/92		Stockett S.E.: close up of crushed perforated pipe from previous photo.

CASCADE MINE DRAINAGE PROJECT
PHOTOGRAPH/SLIDE LEGEND

Number	Date	Site Name	Description
401	6/08/92		Stockett S.E.: exposed interceptor drain at second location near cleanout #27 prior to replacement. Another section of crushed pipe was discovered 4 feet from end of pipe.
402	6/08/92		Stockett S.E.: additional crushed perforated pipe near cleanout #27.
403	6/09/92		Stockett S.E.: total of 11' of crushed perforated pipe removed from near cleanout #27.
404	6/09/92		Stockett S.E.: geocomposite patch placed around replaced perforated pipe near cleanout #27.
405	6/09/92		Stockett S.E.: backfill repaired interceptor drain near cleanout #27. Note clay backfill.
406	6/09/92		Stockett S.E.: excavation to expose crushed perforated pipe near cleanout #26.
407	6/09/92		Stockett S.E.: replaced 4' section of perforated pipe and geocomposite patch near cleanout #26.
408	6/09/92		Stockett S.E.: head of sewer tape used to snake perforated pipe to locate pipe blockages.
409	6/09/92		Stockett S.E.: patched interceptor drain damaged during excavation.
410	6/09/92		Centerville C site: limed soil from Marko's channel placed on north slope.
411	6/09/92		Centerville C site: limed east slope prior to coversoil placement.
412	6/09/92		Centerville C site: east slope during coversoil placement. Coversoil was pushed upslope from base and down from terrace using D-7 dozer.
413	6/09/92		Centerville C site: spreading coversoil on east slope using D-7 dozer. Note JD 555 loader transporting coversoil to terrace.
414	6/10/92		Stockett S.E.: exposed geocomposite and perforated pipe at second location near cleanout #26. Both perforated pipe and geocomposite were crushed.
415	6/10/92		Stockett S.E.: crushed perforated pipe removed near cleanout #26. Backfill suspect.
416	6/10/92		Stockett S.E.: patched geocomposite near cleanout #21 after replacing 1.5' of crushed perforated pipe.

CASCADE MINE DRAINAGE PROJECT
PHOTOGRAPH/SLIDE LEGEND

Number	Date	Site Name	Description
417	6/10/92		Stockett S.E.: exposing interceptor drain near cleanout #38. Water is from plugged perforated pipe.
418	6/10/92		Stockett S.E.: crushed perforated pipe to be removed near cleanout #38.
419	6/10/92		Stockett S.E.: trench wall showing exposed interceptor drain near cleanout #38.
420	6/10/92		Stockett S.E.: crushed perforated pipe (rock on pipe during backfill) removed from near cleanout #38. Pipe was partially filled with orange silt shown on right.
421	6/10/92		Centerville C site: east slope prepared for placement of erosion control mat.
422	6/10/92		Centerville C site: east slope prepared for placement of erosion control mat.
423	6/11/92		Centerville C site: east slope prepared for placement of erosion control mat.
424	6/11/92		Centerville C site: 1 of 2 panorama of site. Limed soils on north slope. Looking toward Marko's property (west).
425	6/11/92		Centerville C site: 2 of 2 panorama of site. Note culvert on right, stock tank in far center and cell 3 on far left.
426	6/11/92		Stockett S.E.: crushed perforated pipe being removed near cleanout #42.
427	6/11/92		Stockett S.E.: crushed perforated pipe being removed near cleanout #42.
428	6/11/92		Stockett S.E.: close up of crushed perforated pipe removed near cleanout #42.
429	6/22/92		Stockett S.E.: center of photo shows geocomposite around crushed perforated pipe near cleanout #46. Rock was removed from this spot.
430	6/22/92		Stockett S.E.: excavated interceptor drain to expose crushed perforated pipe near cleanout #46. Note backfill. Close up of pipe is shown in previous photo.
431	6/22/92		Centerville C site: laying erosion control mat over east slope. Mat is keyed in every 50' down slope.
432	6/22/92		Centerville C site: laying erosion control mat over east slope. Mat is keyed in every 50' down slope.
433	6/22/92		Centerville C site: key trench on terrace at top of east slope.
434	6/22/92		Centerville C site: laying erosion control mat on east slope. Mat is keyed in at top of slope and every 50' downslope.

CASCADE MINE DRAINAGE PROJECT
PHOTOGRAPH/SLIDE LEGEND

Number	Date	Site Name	Description
435	6/23/92		Centerville C site: hydroseeding on upper east slope. Hydroseed being pumped up approximately 100'.
436	6/23/92		Stockett S.E.: slumped area near north wetland channel after reshaping and liming.
437	6/23/92		Stockett S.E.: looking upstream at north wetland channel from previous photo. Acid water in channel is leaking from inlet to channel because temporary by-pass is plugged.
438	6/23/92		Stockett S.E.: upstream end of north wetland channel. By-pass (1" black PVC pipe) is plugged.
439	6/23/92		Stockett S.E.: hydroseeding portions of wetland channel which could be reached from road.
440	6/23/92		Stockett S.E.: hydroseeding portions of wetland channel which could be reached from road.
441	6/23/92		Stockett S.E.: exposing crushed perforated pipe near cleanout #50.
442	6/23/92		Stockett S.E.: perforated pipe removed from interceptor drain near cleanout #50. Crushed pipe regains shape several hours after being removed.
443	6/23/92		Stockett S.E.: geocomposite cut back to expose crushed perforated pipe at second location near cleanout #50.
444	6/23/92		Stockett S.E.: close up of crushed perforated pipe from previous photo.
445	6/23/92		Stockett S.E.: geocomposite cut back to expose crushed perforated pipe near cleanout #51.
446	6/23/92		Stockett S.E.: geocomposite cut back to expose crushed perforated pipe near cleanout #51.
447	6/23/92		Stockett S.E.: close up of removed crushed perforated pipe from near cleanout #51.
448	6/23/92		Stockett S.E.: geocomposite cut back to expose crushed perforated pipe at second location near cleanout #51.
449	6/24/92		Stockett S.E.: close up of crushed perforated pipe removed from near cleanout #27.

CASCADE MINE DRAINAGE PROJECT
PHOTOGRAPH/SLIDE LEGEND

Number	Date	Site Name	Description
450	6/24/92		Stockett S.E.: close up of crushed perforated pipe removed from near cleanout #27. This pipe has already been replaced once. During previous backfill, material was dropped on pipe instead of careful placement.
451	6/24/92		Centerville C site: hydromulched slope and terrace above east slope.
452	6/24/92		Centerville C site: view down east slope from terrace. Hydroseed was sprayed on top of erosion control mat as recommended by the manufacturer.
453	6/24/92		Centerville C site: view from terrace of east slope of hydromulched areas in channel, on Marko's property and on cell dike walls.
454	6/24/92		Centerville C site: view from terrace of east slope of hydromulched areas in channel, on Marko's property and on cell dike walls.
455	6/24/92		Centerville C site: 1 of 2 panorama from south to north overlooking cell 1 and cell 2. Tire tracks in cell 2 where JD 555 was used to dump coversoil on dike walls.
456	6/24/92		Centerville C site: 2 of 2 panorama overlooking cell 2 and cell 3. Note some cattail growth in cell 3, compared to 6/8/92, also weed growth in cell 2.
457	6/24/92		Centerville C site: hydromulched east slope.
458	6/25/92		Stockett S.E.: prepared seed bed prior to seeding near southeast coulee (center).
459	6/25/92		Stockett S.E.: prepared seed bed. View looking northwest from southeast coulee.
460	6/25/92		Stockett S.E.: seeding near southeast coulee. Brillon drill not distributing seed so seed is being broadcast from back of JD 555.
461	6/25/92		Stockett S.E.: seeded, fertilized and mulched area along sides of north wetland channel.
462	6/25/92		Stockett S.E.: seeded, fertilized and mulched area along sides of north wetland channel.
463	6/25/92		Stockett S.E.: slump area along north wetland channel after seeding, fertilizing and mulching.
464	6/25/92		Stockett S.E.: confluence of wetland channels after seeding, fertilizing and mulching.

CASCADE MINE DRAINAGE PROJECT
PHOTOGRAPH/SLIDE LEGEND

Number	Date	Site Name	Description
465	6/25/92		Stockett S.E.: using Bowie mulcher to blow mulch on area near southeast coulee.
466	6/25/92		Stockett S.E.: crushed perforated pipe removed from third location near cleanout #27. Pipe was likely caught and torn during sewer snaking or taping.
467	6/25/92		Stockett S.E.: crushed perforated pipe removed from third location near cleanout #27. Pipe was likely caught and torn during sewer snaking or taping.
468	6/30/92		Centerville C site: using plywood path for Bobcat in cell 2. Bobcat is carrying peat-OM into cell 2 for fine grading.
469	6/30/92		Centerville C site: pec-mat placed in channel from stilling basin to culvert.
470	6/30/92		Centerville C site: placing pec-mat in channel down stream from culvert. Mat is keyed in on edges and every 50' down length of channel.
471	7/07/92		Stockett S.E.: 1 of 3 panorama of site taken from road from north to south during seeding. Shows completed area.
472	7/07/92		Stockett S.E.: 2 of 3 panorama of site taken from road from north to south during seeding. North wetland channel in center.
473	7/07/92		Stockett S.E.: 3 of 3 panorama of site taken from road from north to south during seeding.
474	7/08/92		Centerville C site: stock tank in place north of cell 3 outlet.
475	7/08/92		Centerville C site: stock tank in place looking south toward cell 3.
476	7/08/92		Centerville C site: stock tank in place with control valve in foreground.
477	7/08/92		Centerville C site: outlet from cell 3 (stock tank by-pass) in channel with riprap protection.
478	7/08/92		Centerville C site: 1 of 3 panorama of site from south to north. Shows cell 1.
479	7/08/92		Centerville C site: 2 of 3 panorama of site from south to north. Shows cell 1. Shows crew laying plywood path for Bobcat during placement of hay bale dikes and fine grading.
480	7/08/92		Centerville C site: 3 of 3 panorama of site from south to north. Shows cell 2 outlet to cell 3 in center.
481	7/08/92		Stockett S.E.: using Bowie mulcher to blow mulch over seeded areas.

CASCADE MINE DRAINAGE PROJECT
PHOTOGRAPH/SLIDE LEGEND

Number	Date	Site Name	Description
482	7/08/92		Stockett S.E.: using Bowie mulcher to blow mulch over seeded areas.
483	7/08/92		Stockett S.E.: main access to north end of site, just after seeding with Brillion seeder.
484	7/23/92		Centerville C site: mulching wetland access and staging areas.
485	7/23/92		Centerville C site: mulching wetland access and staging areas.
486	7/29/92		Centerville C site: site overview.
487	7/29/92		Centerville C site: upper NE corner finished slope above terrace, grass growing.
488	7/29/92		Belt Subsidence site: access prior to work.
489	7/29/92		Belt Subsidence site: access and subsidence prior to work.
490	7/29/92		Belt Subsidence site: access prior to work.
491	7/29/92		Belt Subsidence site: exploratory excavation of subsidence.
492	7/29/92		Belt Subsidence site: mobilizing rock backfill.
493	7/29/92		Belt Subsidence site: unloading rock backfill.
494	7/29/92		Belt Subsidence site: unloading rock backfill.
495	7/29/92		Belt Subsidence site: final backfilling and grading.
496	7/30/92		Centerville C site: planting cattails in cell 2.
497	7/30/92		Centerville C site: site overview.
498	7/31/92		Centerville C site: watering newly planted cattails.
499	8/6/92		Centerville C site: 1 of 4 site panorama, access and park.
500	8/6/92		Centerville C site: 2 of 4 site panorama, park and wetland cells, planting last of cattails.
501	8/6/92		Centerville C site: 3 of 4 site panorama, planting last of cattails.
502	8/6/92		Centerville C site: 4 of 4 site panorama, north end.
503	8/6/92		Stockett S.E.: west slope grass starting to show.

CASCADE MINE DRAINAGE PROJECT
PHOTOGRAPH/SLIDE LEGEND

Number	Date	Site Name	Description
504	8/12/92		French Coulee site: exposed manhole location, excavation for valve in background.
505	8/12/92		French Coulee site: inside manhole after grouting.
506	8/12/92		French Coulee site: inside manhole after grouting.
507	8/12/92		French Coulee site: installed valve prior to backfill.
508	8/12/92		French Coulee site: installed valve riser prior to backfill.
509	8/12/92		French Coulee site: broken cleanout riser after excavation.
510	8/12/92		French Coulee site: broken cleanout riser after excavation.
511	8/12/92		French Coulee site: replacement cleanout riser prior to backfill.